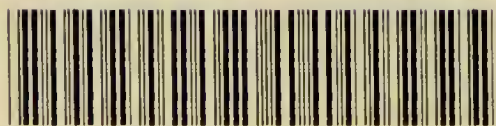


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NEW MALLOPHAGA, I,—WITH SPECIAL REFER-
ENCE TO A COLLECTION MADE FROM MARI-
TIME BIRDS OF THE BAY OF MONTEREY,
CALIFORNIA.

(With Plates ii-xv.)

BY VERNON L. KELLOGG.

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THE MALLOPHAGA—INTRODUCTION.

The Mallophaga constitute a small order of parasitic insects which live externally on the bodies of birds and mammals. The insects are small, one-tenth of an inch being perhaps an average length, wingless, and have biting mouthparts, with which they feed on the feathers or hair of their host, not sucking blood as the true lice do. They have an incomplete metamorphosis. The structure and habits of the insects have until recent years been very

imperfectly understood—even yet the position of the group among insects is but provisionally established (see *postea*), and the knowledge of the life history is strangely incomplete.

In America, besides some account of the commoner forms infesting domestic birds and mammals included in Professor Herbert Osborn's "The Pediculi and Mallophaga affecting Man and the Lower Animals" (Bull. No. 7, 1891, Div. of Ent., U. S. Dept. Agric.), and a discussion by Prof. A. S. Packard (Proc. Amer. Phil. Soc., 1887, vol. xxiv) of the position of the group among insects, practically nothing touching the systematic consideration of the group has been published.

HISTORICAL AND BIBLIOGRAPHICAL.

EUROPEAN.—The Mallophaga are first recognizably mentioned in the writings of Redi. (1668 and 1686), where the common *Trinoton luridum* of the ducks may be recognized in his "louse of the teal," and the common *Lipeurus baculus* of the pigeons is evidently the subject of his description of "*Pulex columbæ majoris*." In the various writings of Albin (1720), Otto Fabricius (1780), J. C. Fabricius (1781, 1787, 1805), De Geer (1778), Linné (1746, 1789), Scopoli (1763), Schrank (1776, 1781, 1804), Panzer (1793), and others, curious accounts and brief descriptions of the common Mallophaga are to be found.

It is to the writings of Christian Ludwig Nitzsch, Professor of Zoology in the University of Halle, in the succeeding century, however, that we turn for a definite memoir which may be recognized as a real beginning of the systematic study of the Mallophaga. Nitzsch's "Die Familien und Gattungen der Thierinsekten (Insecta Epizoica) als ein Prodromus Naturgeschichte derselben."

published in Germar's *Magazin der Entomologie*, vol. iii, 1818, Halle, presents the essential features of the classification of the group now used, and contains the earliest accepted nomenclature. Since the publication of this pioneer memoir four monographic works have been issued, together, needless to say, with numerous lesser memoirs containing descriptions of new species, compiled and more or less comprehensive conspecti of the group in text-books, and morphological treatises.

The monographs indispensable to the student of the Mallophaga are Henry Denny's *Monographia Anoplurorum Britanniae*, or an *Essay on the British Species of Parasitic Insects*, 1842, London, illustrated with colored plates; Christoph Giebel's "*Insecta Epizoa, die auf Säugethieren und Vögeln schmarotzenden Insekten, nach Chr. L. Nitzsch's Nachlass bearbeitet, mit XX Tafeln nach Nitzsch's Handzeichnungen*," 1874, Leipzig; E. Piaget's "*Les Pediculines, Essai Monographique*, vol. i, *Texte*, vol. ii, *Planches*, 1880, *Supplement*, 1885," Leyden; and O. Taschenberg's "*Die Mallophagen, mit besonderer Berücksichtigung der von Dr. Meyer gesammelten Arten*," *Nova Acta der Ksl. Leop.-Carol. Deutschen Akademie der Naturforscher*, Band xlv, No. 1, 1882, Halle. Of these monographs Denny's is limited to a consideration of the parasites found on birds collected in England, his descriptions are too brief, and the colored figures too superficially drawn, so that it is often impossible to recognize from his description and illustration the species of parasite which he had under consideration. Giebel's monograph, as indicated in the title, is based on the unpublished descriptions and drawings of Nitzsch. Giebel also had access to the specimens collected and prepared by Nitzsch. The work is a monumental one, although many of the descriptions are incom-

plete, and the colored illustrations leave much to be desired in the way of accurate detail. Piaget's monographic essay is easily the most valuable treatise on the group, the descriptions being good, the uncolored figures in every way admirable, and the scope of the work truly monographic. Piaget has fairly attempted to include in his original essay a consideration of every species of Mallophaga described up to 1880. In his Supplement he publishes the descriptions of more than 100 new species which have come under his observation. Taschenberg's memoir is the first part of what he hopes to make a complete monograph of the group. It includes the genera *Goniodes*, *Goniocotes*, *Lipeurus*, *Ornithobius*, *Akidoprocetus* and *Trichodectes*. The descriptions of new species are very complete, and the keys to species in the considered genera of great value; the illustrations only, though good, are not up to the exceptionally high standard of the work. Taschenberg, like Giebel, has had access to Nitzsch's types.

Of the lesser systematic memoirs Nitzsch's posthumous papers, edited by Giebel, in the *Zeitschrift für gesammte Naturwissenschaft*, vols. xvii, 1861, xviii, 1861, and xxviii, 1866, are the most important; all of their contents are, however, included in the *Insecta Epizoa*. Next in importance, as far as number of described species goes, are Rudow's papers, consisting of an inaugural dissertation (1869) and several articles in the *Zeitschrift für gesammte Naturwissenschaft*, 1869-1870. Rudow's descriptions are deplorably incomplete; Piaget has practically discarded them in his monograph. Of treatises on the Mallophaga to be found in text-books of general entomology, that in Burmeister's *Handbuch der Entomologie*, 1832, is markedly the most complete.

Finally, of morphological memoirs, those of Kramer on

Lipeurus jejunus (Zeitschr. f. wiss. Zool., 1869, vol. xix, p. 452), of Melnikoff on the embryology of the Mallophaga and of the Pediculidæ (Archiv f. Naturgesch., 1869, vol. xxxv, p. 136), and of Grosse on the anatomy of *Tetraopthalmus chilensis* [= *Menopon titan*] with some comparative studies (Zeitschr. f. wiss. Zool., 1885, vol. xlii, p. 530), are the most important. A full abstract of Grosse's paper was published by Macloskie in the American Naturalist, 1886, vol. xx, p. 340, and is thus readily accessible to American students.

A few descriptions of new species have been published recently by Piaget (Tijdschr. v. Ent., and Notes of the Leyden Museum), and by Picaglia (Atti d. Soc. Ital. di Sci. Nat., and Atti d. Soc. dei Nat. di Modena).

I append a bibliographic list of the more important systematic and morphological memoirs. Full bibliographic lists are to be found in the monographs of Giebel and Piaget. A good list is that published by Picaglia at the beginning of his paper, "Pediculini dell'Istituto anato-mo-zoologico della R. Università di Modena," Atti d. Soc. dei Naturalisti di Modena, 1885, serie 3, vol. iv.

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AMERICAN. As already mentioned in the Introduction, there are practically no American systematic papers on the Mallophaga excepting Professor Herbert Osborn's account of "The Pediculi and Mallophaga affecting man and the lower animals" (Bulletin 7, 1891, Division of Entomology, U. S. Dept. Ag.) Of this bulletin pages 30-54 treat of Mallophaga found on domestic mammals and birds, including the cat, dog, bear (sic), llama, goat, sheep, horse, mule, cow, guinea-pig, pouched gopher (sic), duck, goose, swan, chicken, pigeon, peacock, pheasant, guinea-fowl and turkey. Many of the species

referred to in the bulletin have evidently been observed on animals in America by Professor Osborn, but just how many and what species are not told. One new species, *Trichodectes geomydis*, found abundantly on the Pocket Gopher, is described and figured. I find this species common on *Thomomys talpoides bulbivorous* in this State (California). Among the illustrations of the bulletin are twelve original ones, indicating that at least these twelve species have been personally observed by Professor Osborn.

In the American Monthly Microscopical Journal for November, 1894, Professor Osborn publishes a key to the genera, including in it all of the genera then known, excepting Westwood's *Aucistrona* and Taschenberg's *Eurymetopus* and *Bothorionetopus*.

In the American Naturalist, 1871, in a paper entitled "Certain Parasitic Insects," Professor A. S. Packard names, illustrates, and briefly describes seven new species of Mallophaga collected from American birds. Unfortunately neither the descriptions nor illustrations have been sufficient to enable any one of these species to be recognized by subsequent writers. Similarly Dr. Leidy in the Proceedings of the Academy of Natural Sciences of Philadelphia, refers in briefest terms to a *Menopon* taken from *Pelecanus erythrorhynchos* (Florida) and names it *Menopon perale* (see *Menopon titan*, this paper).

Of other American literature on the Mallophaga, there are in the Proceedings of the Boston Society of Natural History, 1851, brief abstracts of two papers read before the Society by Dr. W. I. Burnett on "the external parasites of warm-blooded animals" and "observations on the relations of an order of parasites (lice) to the different faunæ, as bearing, first on the distinct creation of types of animals, and second on the local creation of

these types wherever they are found." Dr. Burnett noted that "although there are single species (of parasites) peculiar to particular animals, there are others which are found on different species of the same genus as is the case in the parasites living on birds of the genus *Larus* (Gulls) and the diurnal birds of prey." From an examination of the structure of these animals, Dr. Burnett was of opinion that they should be placed in an order by themselves, closely allied to the Insecta; "they number about 250 species, the mandibulate parasites occupying the highest and the haustellate the lowest position in the order." In the second paper Dr. Burnett makes a curious argument for the theory of a special creation of each species of animal based on the facts shown in his study of the distribution of their parasites.

Prof. A. S. Packard read at the meeting of the American Philosophical Society, September 2, 1877, a paper "On the Systematic Position of the Mallophaga," which was published in the Proceedings of the Society, 1887, vol. xxiv, p. 264. Prof. Herbert Osborn has published in *Insect Life*, 1890, vol. iii, p. 115, a "Note on the Period of Development in Mallophaga," and in the same journal, 1891, vol. iv, p. 187, a paper on the "Origin and Development of the Parasitic Habit in Mallophaga and Pediculidæ."

I append a list of the American papers.

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STRUCTURE.

EXTERNAL.—The characteristic external appearance of the Mallophaga is due to a structural condition incident to the parasitic habits of the insects. The body is small, wingless, greatly flattened and usually strongly chitinized. There are no indications of wings in any stage of the insect's life.

Head (fig. 7, plate ii). The head is large in proportion to the whole size of the body, flat (slightly convex above and slightly concave below), and variously crescentic, reniform, quadrangular, triangular, narrowly or broadly conical. It is usually sparsely haired, the hairs appearing specially along the acute lateral margins. The mouth parts and oral opening are on the under side of the head; and the antennæ are outstretched or concealed in excavations on the under side. The most conspicuous character of the fixed parts of the head, other than their extremely flattened condition, is the great development of the clypeus which usually forms the principal part of the head in front of the antennary insertions, and is prolonged as a flat, tapering or expanding, colored or partly uncol-

ored plate, whose anterior margin, variously notched, roundly emarginated, truncated or convex, forms the frontal line of the head. The suture separating the clypeus from the epicranium is usually distinct or unmistakably indicated, sometimes indistinguishable. The hind-head is usually widest across the temporal region, the temples often being strongly expanded laterally with angulated or rounded margin. The occipital region is usually concave, so that the head sits "hat-like" on the prothorax. The head presents certain chitinous bands projecting forward from the occipital margin, inwardly from the eyes, forward from the bases of the antennæ, etc. The presence or absence and the character of these bands are used as distinguishing specific characters, and the bands are named and defined in the Terminology (see *postea*).

The antennæ (figs. 10, 11 and 12, plate ii) are short, 3-, or 4-, or 5-segmented and vary much in shape and character. They are filiform (suborder Ischnocera) or clavate or capitate (suborder Amblycera), and sometimes differ in the two sexes of the same species. When this is the case they are the antennæ of the male which depart from the typical condition, showing appendages on one or more segments, probably used for grasping the female. The antennæ arise from or near the lateral margins of the head, and usually from about the middle of the margin. The fossa may be deep or shallow; its angles projecting and acute or short and rounding; and the antennæ may project directly and always from the head (suborder Ischnocera) or they may lie concealed in excavations on the under side of the head (suborder Amblycera).

The eyes are simple and are located in the lateral margins of the hind-head not far behind the antennary fossæ, in a deep or shallow ocular emargination of the lateral

margin, or on the non-emarginated margin. They are two in number, although each is sometimes slightly or almost completely divided by an angular emargination. They are flatly convex to hemispherical, and clear to strongly colored.

The mouth parts (figs. 7, 8, 9, plate ii), situated on the under side of the head, and variously from the middle of this aspect to the frontal margin, are fitted for biting and consist of rather large, strongly chitinized, usually two-toothed, usually sharply pointed mandibles, inconspicuous and as yet imperfectly known maxillæ without *palpi, and a labium of various character and size; either large and with 4-segmented palpi (family Liotheidæ) or small and without palpi (family Philopteridæ). Despite the good work of Grosse the knowledge of the mouth parts of the Mallophaga is still manifestly incomplete.

Thorax. The thorax, which is composed usually of but two segments (three in but three genera), the meso- and metathorax being indistinguishably coalesced, is flat, larger than broad, and variously shorter than the head to much longer than the head (in one species as long as the abdomen). The lateral borders of both sclerites are strongly chitinized. The metathorax sometimes closely resembles an abdominal segment and is often closely joined to the first abdominal segment. The prothorax usually bears one to a few stiff hairs on its lateral margins; the metathorax often bears in addition to the hairs almost always present in the lateral angles, a series of long, strong hairs ranged along the posterior margin. These hairs may arise from small uncolored (unchitinized) spaces and

* The earlier writers, Nitzsch *et al.*, ascribe the visible palpi to the maxillæ; Grosse is positive of their labial connection. A study of the anatomy of the Mallophaga, now being made in my laboratory, will, it is hoped, afford some further data on the mouth parts subject.

project upwards, being undoubtedly tactile organs. In the case of the three genera in which the mesothorax can be distinguished from the metathorax, this separation is especially evident in immature specimens, as would be expected in the case of a specialization by reduction.

The legs (fig. 13, plate ii) are strong and of variable length; the forelegs are the shortest and are used as foot-jaws for carrying food to the mouth. When at rest the forelegs project forward beneath the head. The coxæ are usually short (long and projecting beyond the lateral margins of the thorax in one genus) and are rarely appendaged. The femora vary from long, subcylindrical, to short, thick, subovoid; the tibiæ are usually shorter than the femora (sometimes as long, rarely longer) and slender, and are armed at the distal extremity with spines and sometimes, in the males, with special structures for holding the female. Both femora and tibiæ bear from a few to many short to long hairs; sometimes series of short, strong spines. The tarsi are 2-segmented, the distal segment with one (mammal-infesting forms) or two (bird-infesting forms) claws, the first segment of the tarsus is short and with or without one or two small lobes; the second segment is short (family Philopteridæ) or elongate and slender (family Liotheidæ) and bears a pulvillus between the claws.

Abdomen. The abdomen is flat, short, oval to long and slender, often differs in the sexes, especially in the shape and character of the posterior margin of the last segment, and is composed of 9 (sometimes apparently 8) or 10 segments. It may be almost naked or pretty thoroughly clothed with hairs, and bears almost always one to several short to long hairs in the posterior lateral angles of each segment, which angles sometimes project acutely. The hairs on the dorsal surface, as on the

thorax, sometimes arise from small, circular, uncolored spaces, when they are said to be "pustulated." The last segment is variously elongate, short, with emarginate, truncate or convex posterior margin, which is evenly or unevenly fringed with short to long hairs. The lateral margins of thesegments are usually strongly chitinized, the chitin being sometimes translucent, but usually dark brown to black.

INTERNAL.—For our present knowledge of the internal anatomy of the Mallophaga we are indebted chiefly to Nitzsch, Kramer and Grosse. Among the points of special interest presented by the internal structure are the concentration of the nervous system and the differing types of crop in the two sub-orders.

Alimentary Canal (figs. 1 and 2, plate ii). The œsophagus of the Amblycera simply expands widely to form a crop; in the Ischnocera the crop appears as a conspicuous diverticulum or lateral sac of the œsophagus. The crop often bears spines or teeth on its inner wall. There are two pairs of salivary glands, variously cylindric, clavate, sub-spheroid, reniform, or divided into many small cylindrical tubes. The stomach usually presents two forward-projecting sac-like expansions. There are four thread-like, unbranched, Malpighian tubules.

Genitalia (figs. 4 and 5, plate ii). In the male there are paired testes, two sperm-ducts uniting to form an ejaculatory duct, accessory glands and a protrusible penis, with chitinized, often elongated, side-pieces. The female has paired ovaries ("three pairs of ovarian tubes in Liotheidæ, five pairs in Philopteridæ"), two oviducts uniting before issuance, and a seminal receptacle (called by Nitzsch "Kittdruse," but by Kramer and Grosse a receptaculum seminalis).

Dorsal Vessel. Kramer found the heart of *Lipeurus*

jejunos to be a long delicate tube with expanded, turnip-like, posterior extremity. The "wing-muscles" are greatly reduced. There are but four openings for the ingress of the blood, which is not rich in white corpuscles. Wedl was able to study the heart of *Menopon pallidum*, but Grosse could not succeed in making preparations showing the heart of *Tetraophthalmus chilensis* [= *Menopon titan*].

Respiratory System (fig. 6, plate ii). In *Menopon titan* I have found six pairs of abdominal spiracles (segments 3-8) and a pair of prothoracic spiracles. There are two large longitudinal trunks and one large transversal trunk (segment 4 of the abdomen) in *titan*.

Nervous System (fig. 3, plate ii). There are two head ganglia, the supra-œsophageal and the infra-œsophageal, and three thoracic ganglia lying close together. There are no abdominal ganglia, the hindmost thoracic ganglion sending back into the abdomen two large nerves, whose branches provide the abdominal viscera with nerves.

LIFE-HISTORY AND HABITS.

The Mallophaga have an incomplete metamorphosis. The eggs are elongate-oval, are fastened singly by some gluey substance to the vanes or barbs of the feathers, and the young issue by breaking off a circular cap or lid at the larger free end of the egg. The duration of the egg stage has not been determined for any species. A number of eggs of *Nitzschia pulicæ* (host, the Chimney Swift, *Chaetura pelagica*), collected by P. H. Rolfs (Ames, Iowa), and kept, some of them, "in a tight paste-board box in his vest-pocket, the others enclosed in cotton-plugged tubes under a setting hen," incubated under these circumstances in from 13 to 20 days. The age of the eggs at time of collecting was not known. The young

resemble the parents in essential characters; the noticeable differences are the comparatively larger head, the smaller, especially shorter, abdomen, and the absence or incompleteness of the markings, especially those of the abdomen. The color of the very young is always whitish; as they grow older chitinization follows and the brown and black colors appear (see plates). The number of moults or the duration of immaturity is not known for any species. I have observed nymphs (presumably in the stage preceding the final moult) which were fully as large as the adults of the same species. I have figured the immature stages for one or more species in nearly all the genera met with by me on the water and shore birds (see plates). In none of the monographic works is there any attention paid to the young. From the preceding brief account it is obvious that the life-history of the Mallophaga is as yet practically unknown.

Parasitism. The parasitic habits of the Mallophaga have been the subject of some little study, mainly directed to ascertaining whether or not the blood of the host ever forms a part of the food of the parasite. From the condition of the mouth parts and from repeated examination of the contents of the crop the food of the Mallophaga is affirmed to be the epidermal scales and the hair or feathers of the host. The conspicuous large, dark, pear-shaped blotch in the abdomen found in a majority of individuals examined is discovered, on careful examination, to be the crop and its contents, composed of bits of feathers showing through the semi-transparent body of the insect. In Nitzsch's drawings, illustrating the Insecta Epizoa, this food-filled crop appears in many of the individuals figured. Denny's figures also show the discolored crop. Of course such a "marking" is an evanescent one: immediately after a full meal it would be present; later, after diges-

tion, it would be wanting. A few instances are recorded of the presence of blood in the crop, but it has been suggested, with much show of probability, that the blood was such as might not infrequently, because of wounds, be found by the parasite on the feathers, perhaps dried and hard. There is one instance, however, known to me among the habits of the parasites which cannot be so readily explained. *Menopon titan* var. *linearis* of the California Brown Pelican (*Pelecanus californicus*) is found commonly clinging to the inner surface of the gular pouch. The clinging is accomplished by the use of the mandibles, each parasite of the half dozen individuals which may be grouped together having its mandibles inserted in the skin of the pouch. The mandibles are not thrust in suddenly on touching the insect with the collecting forceps, but the insects are always, as far as observed, firmly lodged. Indeed some effective clinging would be necessary always to prevent the carrying away of the parasites by the water taken into the pouch of the pelican in feeding. In several instances a small region surrounding the parasites was raw and bloody. What is it that serves these parasites for food? Perhaps, of course, simply the epidermal scales of the inner wall of the pouch.

The abundance of certain species of Mallophaga, like *Menopon pallidum*, on domestic poultry causes the hosts much inconvenience and sometimes actual injury. The injury is done by the irritation of the skin of the host by the sharp-clawed feet of the hordes of parasites, rather than by any direct hurt through the feeding. After the death of the host, the parasites either attempt to leave the body, usually migrating slowly toward the head, or simply die on the body. The death of the parasites remaining on the body usually ensues in two or three days. I have observed the death of some in four or five hours,

and, on the other hand, have collected live parasites from a bird skin seven days old. The death of the parasites can hardly be caused by starvation, in view of their feeding habits, but rather must be attributed to the lack of animal heat which they have been accustomed to during the life of the host.

Mallophaga which infest swimming and diving birds are not furnished with special contrivances for their pseudo-aquatic life. They, in fact, never come, necessarily, into contact with the water, living, as they do, at the roots of the feathers where the water can never penetrate, and where they have a constant and sufficient supply of air for the longest submergence possible to the host.

The origin of the parasitic habit among the Mallophaga and its influence on their structure are questions of much interest, but ones which cannot be touched on here.

Some of the phenomena of the relations of parasites to hosts, the migration of the parasites, and the influence of their peculiar habits on the rapid establishing of variations, are considered in the following paragraphs under the head of "Distribution."

DISTRIBUTION.

The Mallophaga are parasites which live for their whole life on the body of the host; only in rare instances are the insects to be found off the host's body. The common louse of the hen, *Menopon pallidum*, has been found walking on the roosts or elsewhere in the chicken houses. But the Mallophaga are not "stationary parasites" of that extreme type in which the organs of locomotion are lost; and the infesting of new hosts is accomplished by actual migration of individuals from one bird to another. It is obvious that for any one bird-species this migration

may be readily accomplished: (a) from male to female, or *vice versa*, during copulation; (b) from parent to young, during the nesting season. In both of these cases there is actual contact of the hosts. If at other times in the life of the host it comes into actual contact with other birds of its own species migration of parasites can take place. Such cases must occur among birds of gregarious habits; the crowding together of gulls on small masses of floating sea-weed, or on masses of food, or on the rocks of the shore, must bring about actual contact of the bodies of the birds. But, as common observation shows, there are in the crowding groups of gulls individuals of different species. Thus in these cases there is possible a migration of parasites from one bird-species to another, these species in the case of the gulls being closely related ones—species belonging, in fact, to one genus. But on the “roosts” of maritime birds, the cliffs of the shore and the outlying rocks, birds of very different kinds sit huddled together. Along the rocky shores of Point Pinos on the Bay of Monterey, pelicans, cormorants and gulls gather in great numbers and perch side by side on favorite “roosts.” It seems as if migration of parasites from one to another of these bird-species could here, and elsewhere under similar conditions, often be accomplished; and I have found *Lipenurus toxoceras*, described by Nitzsch from a cormorant, on both a cormorant and a pelican shot on this shore. Other cases of contact occur between birds of prey and their victims (I have noted a *Physostomum*, a genus confined normally to passerine birds, on a sparrow-hawk); and in those few groups of closely allied forms among which hybridization occurs, as with the ducks. Still other opportunities for accidental or normal contact between birds of different species will suggest themselves to the student.

The opportunities for migration so far referred to are sufficient to account for the spreading of a parasite species among individuals of its host species, and for the condition presented in cases like those of *Docophorus lari* and *Nirmus lineolatus* common to many species of gulls, and those of *Triuotou luridum* and *Docophorus icterodes* common to many species of ducks: cases where the birds are of gregarious habits, or where hybridization occurs.

But of those cases of a parasite common to two or more bird-species, one or more of which are Old World forms and the other or others New World forms, a further explanation is necessary. In this paper I ascribe to Mallophagous species described from specimens taken on birds of Europe or elsewhere not on the American continent specimens of twenty-two different species of Mallophaga taken on American birds. Examples of such occurrence are *Nirmus signatus* and *N. pileus* from the American Avocet (*Recurvirostra americana*) and described by Piaget and Nitzsch from specimens taken on the European Avocet (*Recurvirostra avocetta*); *Docophorus pertusus* from *Fulica americana* (America), originally described from *Fulica atra* (Europe), and so on. In rare instances we find a bird-species common to both the Old World and the New World: certain birds of circumpolar range, as *Cephus grylle*, and exceptional cases like that of *Puffinus major*, come in this category. The parasites of these birds will of course be common to America and to Europe. But such instances are rare. A few other cases may exist in which certain strong-flying maritime American and European or Asiatic birds may meet occasionally on some midoceanic island and a migration of parasites be effected. Such instances, also, are exceptional. The occurrence of a parasitic species common to European and American birds, which is not an infrequent matter (out of the sixty

species of Mallophaga referred to in this paper as being taken on American birds one-third are referable to species previously described from European or Asiatic birds), must have another explanation than any yet suggested. This explanation, I believe, is, for many of the instances, that the parasitic species has persisted unchanged from the common ancestor of the two or more now distinct but closely allied bird-species. With the spreading of the ancestral bird-species, geographical races have arisen within the limits of the species which have, with time and isolation caused by newly appearing geographical barriers (due to geologic or climatic changes), come to be distinct species—species often distinguished only by superficial differences in color, etc. The parasites have remained practically unaffected by the conditions which have produced the differences among the birds; the temperature of the host's body, the feathers *as food*, all of the environment is essentially unchanged in its relation to the parasite. The parasitic species thus remains unchanged, while the first *Larus* species or *Anas* species becomes differentiated into a dozen or score of specific forms, all with a common parasite.

In substantiation of this explanation of a common possession of a parasitic species by Old and New World birds some examples may be referred to. As already mentioned, I have found on *Fulica americana* the same species of parasite, *Docophorus pertusus*, described by Nitzsch from specimens taken from the European *Fulica atra*; *Docophorus melanocephalus* taken by me on *Sterna maxima* is recorded by European authors from *Sterna caspia* and *S. cantiaca*; *Nirmus punctatus*, found by me on *Larus occidentalis* was described by Nitzsch from *Larus ridibundus* and has been found by Piaget on *Larus dominicans* from Chile and on *Larus ichthyæus* from the

Volgas; *Nirmus signatus* and *N. pileus* found by me on *Recurvirostra americana* were described by Piaget and Nitzsch respectively from *Recurvirostra avocetta*, the European Avocet; *Lipenrus ferox* taken by me on *Diomedea albatrus* is recorded by European writers from *Diomedea exulans*, *brachyura* and *melanophrys*; *Lipenrus forficulatus* taken by me on *Pelecanus erythrorhynchus* and *P. californicus* was described by Nitzsch from *P. onocrotalus*; and similarly the most of the twenty-two previously described species taken by me from American birds might be thus offered as examples. We have in all of these cases the common parasite occurring on the American representatives of the genus to which the original Old World host belongs. Looking now for the exceptions to this condition—namely, for instances where the known species when found on an American bird is found on one widely separated phyletically from the European host—we find no clearly defined instance of this condition, no instance where association during life or “straggling” after death of the host can be put aside as possible explanations of the presence of the parasite on the unexpected host.

There are to be noted other results of the influence on the taxonomy of the Mallophaga of the peculiar conditions of their parasitic life. While the uniformity and persistence of the conditions under which the life of the parasites is passed tends to preserve with little change the species types, the peculiar isolation, often pretty complete, of groups of individuals of a parasite species on individual birds of the host species and the consequent close breeding tend to foster and fix those inevitable slight variations always manifest in a comparison of offspring and parents, but under normal conditions held in check or lost (unless directly advantageous) by

crossing among less closely related individuals. For example the individuals of a parasite species on a bird of long life and non-gregarious and monogamous habits, like an eagle, live very much the life of an isolated community. There must be many years of in-and-in breeding. It is like island life. The result is certain: the members of this isolated group will soon differ from the specific type in noticeable particulars. On the other hand, the conditions of life on this "island" are practically identical with the conditions on other similar "islands"—other eagles—inhabited by other individuals of the same parasite species, so there is no influence working to produce a wide divergence of the members of these various isolated groups of individuals of the same species. Now this isolation of groups of individuals is in some degree an incident of the life of all Mallophaga; in some instances it is considerable; in others, inconsiderable, but taken altogether a condition in the life of the whole order exerting an influence which has the readily recognizable result of creating a great number of small variations within species limits.

We have noted now two influences resulting from the peculiar habits of the Mallophaga which are somewhat opposed to each other. One influence, due to the uniform (as far as relation to parasite goes) conditions of the habitat, the body of the host, tending to preserve essentially unchanged the type-forms of the parasites; the other influence, due to the isolation of groups of individuals and the consequent close breeding, tending to foster and fix small variations. The results, manifest to any student of the group, are to render difficult the division of the order into distinct genera on account of the general similarity of structure, and to make difficult the definition of species on account of the many-slight variations among

the individuals from different bird individuals. While I believe myself able to refer specimens taken from American birds to a score of species described from specimens taken from European and Asiatic birds, in all of these instances there are slight but recognizable differences between the American specimens and the type-forms of the species (as well as I am able to make comparison, having only the drawings and descriptions of these type-forms to refer to).

The differences in relative abundance or rarity of the individuals of a species, and in the relative freedom or seriously infested condition of the hosts may be referred to briefly. Certain specific examples will serve to illustrate the various conditions. In the first place the host species may have several parasitic species as *Diomedea albatrus*, *Fulmarus glacialis* vars. *glupischa* and *rodgersii* and *Fulica americana*, each with six species of parasites; or the host species may have but one (very rarely) or two or three parasitic species infesting it, as with most of the ducks and gulls. A parasitic species may be constant in its appearance on the individuals of its host species, as *Docophorus lari*, almost certain to be found on any gull specimen shot, *Lipeurus celer*, which I found on twenty-nine out of thirty specimens of *Fulmarus glacialis* vars. *glupischa* and *rodgersii* examined, *Docophorus occidentalis* similarly found on twenty-nine out of these thirty Fulmars; or it may be found on but few individuals of the host species, as *Docophorus quadraticcps* found on one of fourteen specimens of *Fulica americana* examined, and *Nirmus præstans* found on two of fourteen specimens of *Sterna maxima* examined. There may be many individuals of a parasitic species always present on the body of the host, as with *Lipeurus celer* on the Fulmars, of which parasite I have collected nearly one hundred specimens

from a single bird, and which is always abundantly present on its host; or the individuals may be few even though the parasite is a constant one, *i. e.*, almost always to be found on any specimen of the host examined. *Trinoton luridum* of the ducks is a good example of this constant presence in small numbers. There may be more than one species of the same genus of parasites on a single host, as *Lipeurus celer* and *Lipeurus varius*, both numerous on the Fulmars; but usually the different parasites of a host represent different genera, exemplified by the remaining four species of parasites of the Fulmars which belong to four other and different genera.

Finally, I may append to these desultory remarks concerning the distribution of the Mallophaga and the influence on their taxonomy of their peculiar habits of life a list of those bird hosts with their parasites, the examination of which has afforded the data for this paper. In preparing the list I have eliminated all instances of undoubted "straggling."

LIST OF HOSTS WITH PARASITES.

Colymbus nigricollis californicus.	Synthliborhampus antiquus.
Docophorus lari.	Docophorus montereyi.
kansensis.	atricolor.
Menopon tridens var. insolens.	Menopon loomisii.
Urinator pacificus.	Brachyrhampus marmoratus.
Docophorus colymbinus.	Docophorus montereyi.
graviceps.	atricolor.
Oncophorus advena.	Uria troile californica.
Menopon tridens var. pacificum.	Docophorus calvus.
Urinator lumme.	Rissa tridaetyla pollicaris.
Docophorus colymbinus.	Docophorus lari.
lari.	Larus glaucus.
graviceps.	Docophorus lari.
Nirmus farallonii.	Larus glaucescens.
Ceratorhina monoceerata.	Docophorus lari.
Docophorus acutipectus.	Nirmus lineolatus.
Ptychorhampus alenciens.	Colpocephalum funebre.
Docophorus montereyi.	Menopon infrequens.
Menopon loomisii.	

- Larus occidentalis.*
 Docophorus lari.
 Nirmus lineolatus.
 punctatus.
Larus argentatus smithsonianus.
 Docophorus lari.
 Nirmus lineolatus.
Larus vegæ.
 Docophorus lari.
 Nirmus lineolatus.
Larus californicus.
 Nirmus lineolatus.
Larus delevarensis.
 Docophorus lari.
 Nirmus lineolatus.
 punctatus.
Larus brachyrhynchus.
 Docophorus lari.
 Nirmus lineolatus.
Larus canus.
 Docophorus lari.
 Nirmus lineolatus.
Larus heermanni.
 Docophorus lari.
 Nirmus lineolatus.
 felix.
Sterna maxima.
 Docophorus melanocephalus.
 Nirmus præstans.
 hebes.
 lineolatus.
Sterna forsteri.
 Menopon tridens var. *insolens.*
Diomedea albatrus.
 Nirmus giganticola.
 Lipeurus ferox.
 densus.
 Eurymetopus taurus.
 Colpocephalum pingue.
 Menopon navigans.
- Fulmarus glacialis glupischa.*
 Docophorus occidentalis.
 Lipeurus celer.
 varius.
 Eurymetopus taurus.
 Ancistrona gigas.
 Menopon numerosum.
Fulmarus glacialis rogersii.
 Docophorus occidentalis.
 Lipeurus celer.
 varius.
 Eurymetopus taurus.
 Ancistrona gigas.
 Menopon numerosum.
Puffinus opisthomelas.
 Lipeurus diversus.
 limitatus.
 testaceous.
 Giebelia mirabilis.
Puffinus griseus.
 Lipeurus diversus.
 limitatus.
 Giebelia mirabilis.
Phalacrocorax dilophus albociliatus.
 Docophorus lari.
 Nirmus farallonii.
 Lipeurus toxoceras.
Phalacrocorax penicillatus.
 Nirmus farallonii.
Pelecanus erythrorhynchus.
 Lipeurus forficulatus.
 Colpocephalum unciferum.
 Menopon titan var. *impar.*
Pelecanus californicus.
 Docophorus lari.
 Lipeurus forficulatus.
 toxoceras.
 Colpocephalum unciferum.
 Menopon titan var. *linearis.*

<i>Merganser serrator.</i>	<i>Oidemia deglandi.</i>
<i>Docophorus icterodes.</i>	<i>Docophorus icterodes.</i>
<i>Lipeurus temporalis.</i>	<i>Oidemia perspicillata.</i>
<i>squalidus.</i>	<i>Docophorus icterodes.</i>
<i>Merganser americanus.</i>	<i>Lipeurus constrictus.</i>
<i>Lipeurus squalidus.</i>	<i>Erismatura rubida.</i>
<i>Trinoton luridum.</i>	<i>Docophorus icterodes.</i>
<i>lituratum.</i>	<i>pertusus.</i>
<i>Anas boscas.</i>	<i>Trinoton luridum.</i>
<i>Docophorus icterodes.</i>	<i>Ardea egretta.</i>
<i>Trinoton luridum.</i>	<i>Colpocephalum laticeps.</i>
<i>lituratum.</i>	<i>Fulica americana.</i>
<i>Anas americana.</i>	<i>Docophorus pertusus.</i>
<i>Trinoton luridum.</i>	<i>Lipeurus picturatus.</i>
<i>Anas carolinensis.</i>	<i>longipilus.</i>
<i>Trinoton luridum.</i>	<i>Oncophorus advena.</i>
<i>Spatula clypeata.</i>	<i>Laemobothrium atrum.</i>
<i>Trinoton luridum.</i>	<i>Menopon tridens</i> var. <i>pacificum.</i>
<i>Dafila acuta.</i>	<i>Recurvirostra americana.</i>
<i>Docophorus icterodes.</i>	<i>Nirmus signatus.</i>
<i>Trinoton luridum.</i>	<i>pileus.</i>
<i>lituratum (?)</i>	<i>Colpocephalum uniforme.</i>
<i>Aythya americana.</i>	<i>Menopon indistinctum.</i>
<i>Docophorus icterodes.</i>	<i>Charadrius squatarola.</i>
<i>Aythya affinis.</i>	<i>Docophorus fuliginosus.</i>
<i>Docophorus icterodes.</i>	<i>Charadrius dominicus.</i>
<i>Charitonetta albeola.</i>	<i>Nirmus orarius.</i>
<i>Lipeurus squalidus.</i>	<i>Colpocephalum timidum.</i>

POSITION AMONG INSECTS.

What the position of the Mallophaga among insects is, is still a moot question, as indeed, strictly speaking, is the position of any one of the groups. The Mallophaga by reason of their habits have been constantly associated in entomological literature with the Pediculidæ. It is hardly worth while here to trace the Mallophaga in their tortuous path through the various schemes of insect classification from the times of Redi to the present day. It has not been until comparatively recent years that the facts of structure and life history upon which the classification of any group depends were known in the case of the Mallo-

phaga. The classificatory attempts prior to that time were simply the results of conjecture.

Grouped for a long time with the Hemiptera, because the Mallophaga are, what the Pediculidæ, undoubted Hemiptera, are, external parasites of animals, the testimony of the biting mouthparts finally effected their removal to that heterogeneous group of insects, the order Pseudo-Neuroptera. Here they came to be associated, in all of these steps more and more nearly approximating the truth, with the Termites, Psocids, Perlids and Embids, these groups forming the suborder Platyptera. Dr. Brauer in 1885 broke up the order Pseudo-Neuroptera, and after this cataclysm our Mallophaga found themselves in company with the Termites and Psocids constituting the order Corrodentia. Finally under the impetus thus acquired in order-breaking many entomologists have gone further, and in the hands of these men the Mallophaga reach the standing of an independent order. The latest American text-book of entomology, Comstock's Manual of Insects, 1895, adopts this treatment of the group.

Whether a group of insects should be called an order or a suborder or what not is largely, of course, a matter of an author's attitude in matters classificatory. The point manifest in all this shifting about and gradual growth of ranking importance of the Mallophaga is that the group is one well removed from any other group of insects. The more the structure and life history of the bird-lice have been studied, the more difficult it has become to ally them closely with any other insects. The, at first glance, apparently simple and lowly structure of them is discovered by study to be the result of a specialization along the lines of parasitism. The simplicity of outer habitus, lack of wings, the rather Thysanuriform appearance are not the simplicity of a general-

ized, of a racial condition, but of a specialization, albeit in the line of reduction or degradation. With the simple general structure there goes a highly concentrated nervous system, greatly modified mouth parts, and curiously specialized antennæ.

The thorough study of the life-history, embryonic and postembryonic, is needed to throw more light on the position of the Mallophaga. Till such study is made, the present isolated position assigned the group, based on the known structure of the adult and on its habits, may be accepted as representing the consensus of authority.

CLASSIFICATION.

The Mallophaga were divided by Nitzsch into two families, the Philopteridæ, with filiform antennæ and without maxillary palpi, and the Liotheidæ, with capitate 4-segmented antennæ and maxillary palpi. The family Philopteridæ included two genera, *Trichodectes*, with 3-segmented antennæ and 1-clawed tarsi, and *Philopterus*, with 5-segmented antennæ and 2-clawed tarsi. The latter genus was subdivided into the five subgenera, *Docophorus*, *Nirmus*, *Goniocotes*, *Goniodes*, *Lipeurus*. The family Liotheidæ similarly included two genera, *Gyropus*, with 1-clawed tarsi, and *Liotheum*, with 2-clawed tarsi. The latter genus was subdivided into six subgenera, *Eureum*, *Læmobothrium*, *Physostomum*, *Trinoton*, *Colpocephalum* and *Menopon*. The two 1-clawed genera *Trichodectes* and *Gyropus* were found by Nitzsch exclusively upon mammals; all the other genera exclusively upon birds.

In essential identity the classification of to-day is that of Nitzsch; it differs in discarding the generic groups *Philopterus* and *Liotheum*, and in considering the Nitzschian subgenera as genera, and in the addition of several new genera.

That change by which the one-time subgenera of *Philopterus* are now put on equality with the genus *Trichodectes*, and similarly the subgenera of *Liotheum* on equality with *Gyropus*, seems to me ill-advised. The two genera found on mammals differ so radically and in so many ways from their related genera in each family that I believe their striking host and structural differences should be emphasized in the classification. I propose, therefore, in the light of the present position of the Mallophaga as an independent order of insects, to rank the Nitzschian families as suborders, and the Nitzschian genera as families, and the Nitzschian subgenera, the genera of present day writers, as genera. This will leave unchanged the present generic names and ranking, but will restore the expression, first indicated by Nitzsch in his generic rankings, of differences between the mammalian parasites and the avian parasites. This re-ranking, which is practically a return to classification of Nitzsch, finds expression in the keys and synopses which I have arranged to receive all of the genera so far recognized.

Although the Mallophaga include already nearly 1000 described species there are but few genera and these genera are difficult to separate. In other words, the whole group is a series of closely related and intergrading forms. The causes and conditions of this state of affairs I have already attempted to explain in the paragraphs under the head of "Distribution" (*antea*). In this place the facts of this close inter-relation come home to us in the attempt to arrange keys for the separation of the genera. I found trouble, when beginning the study of the Mallophaga, in distinguishing by the published keys certain genera; whether a Philopterid parasite was a *Docophorus* or a *Nirmus*, or whether a Liotheid parasite was a *Mcnopon* or a *Colpocephalum*, were questions

not definitely answered by the key. In introducing into the key the genera which have been described since the making of the key used in the European monographs, I find naturally increasing difficulties; so I have accompanied the key with a synopsis of all of the described genera, calling attention to the characters which go to give any genus its peculiarly characteristic appearance. With the key and the diagnosis I hope that any genus can be satisfactorily determined. For definitions of the terms used in referring to various structures of the Mallophaga, see the Terminology, following the synopsis.

KEY TO THE SUBORDERS.

- A. With filiform 3- or 5-segmented antennæ, and no labial palpi.
Suborder ISCHNOCERA.
- AA. With clavate or capitate 4-segmented antennæ, and 4-segmented labial palpi.
Suborder AMBLYCERA.

KEY TO THE GENERA OF THE SUBORDER ISCHNOCERA.

- A. With 3-segmented antennæ; tarsi with 1 claw; infesting mammals (family Trichodectidæ).
TRICHOECTES N.
- AA. With 5-segmented antennæ; tarsi with 2 claws; infesting birds (family Philopteridæ).
- B. Antennæ similar in both sexes.
 - C. Front deeply angularly notched.
AKIDOPROCTUS P.
 - CC. Front convex, truncate, or rarely with a curving emargination, but never angularly notched.
 - D. Species broad and short, with large movable trabeculæ (at the anterior angle of antennary fossa).
 - E. Forehead with a broad transverse membranous flap projecting beyond lateral margins of the head in the male, barely projecting in female.
GIEBELIA Kellogg.
 - EE. Without such membranous flap.
DOCOPHORUS N.
 - DD. Species elongate, narrow; with very small or no trabeculæ.
NIRMUS N.
- BB. Antennæ differing in the two sexes.
 - C. Species wide, with body elongate-ovate to sub-orbicular.
 - D. Temporal margins rounded; last segment of abdomen roundly emarginated; antennæ of male without appendage, third segment very long.
EURYMETOPUS Tasch.

- DD. Temporal margins usually angulated; last segment of abdomen convex, rarely angularly emarginated with two points.
- E. First segment of antenna of male large, sometimes with an appendage; third segment always with an appendage. GONIODES N.
- EE. First segment of antenna of male enlarged, but always without appendage; third segment without appendage; last segment of abdomen always rounded behind. GONIOCOTES N.
- CC. Species elongate, narrow, sides sub-parallel.
- D. Third segment of antenna of male without an appendage. ORNITHOBIUS Denny.
- DD. Third segment of antenna of male with an appendage.
- E. Front deeply angularly notched. BOTHRIOMETOPUS Taseh.
- EE. Front not angularly notched.
- F. Antennæ and legs long; a semicircular oral fossa. LIPEURUS N.
- FF. Antennæ and legs short; oral fossa narrow, elongate, extending as a furrow to the anterior margin of the head. ONCOPHORUS Rudow.

KEY TO THE GENERA OF THE SUBORDER AMBLYCERA.

- A. Tarsi with 1 claw; infesting mammals (family Gyropidæ). GYROPUS N.
- AA. Tarsi with 2 claws; infesting birds (except *Boopis*?) (Family Liothidæ.)
- B. Ocular emargination distinct, more or less deep.
- C. Forehead rounded, without lateral swelling; antennæ projecting beyond border of the head. COLPOCEPHALUM N.
- CC. Forehead with strong lateral swellings.
- D. Antennæ projecting beyond border of the head; temporal angles projecting rectangularly; eye large and simple. BOOPIS P.
- DD. Antennæ concealed in groove on under side of the head; temporal angles rounded, or slightly angular; eye divided by an emargination and fleck.
- E. Mesothorax separated from metathorax by a suture. TRINOTON N.
- EE. Meso- and metathorax fused; no suture. LEMOBOTHRUM N.
- BB. Ocular emargination absent or very slight.
- C. Sides of the head straight or slightly concave, with two small laterally-projecting labral lobes. PHYSOSTOMUM N.

- CC. Sides of the head sinuous; forehead without labral lobes.
 D. Body very broad; metathorax shorter than prothorax.
EUREUM N.
 DD. Body elongate; prothorax shorter than metathorax.
 E. Ocular emargination filled by a strong swelling;
 sternal markings forming a quadrilateral without
 median blotches. NITZSCHIA Denny.
 EE. Ocular emargination without swelling, hardly ap-
 parent or entirely lacking; median blotches on
 sternum.
 F. Very large; with two 2-pointed appendages on
 ventral aspect of hind-head; anterior coxæ with
 very long lobe-like appendages.
ANCISTRONA Westwood.
 FF. Small or medium; without bi-partite append-
 ages of hind-head. MENOPON N.

SYNOPSIS OF MALLOPHAGA.

Suborder ISCHNOCERA.

With the antennæ filiform, 3- to 5-segmented, sometimes differing in the sexes; no labial palpi.

Family TRICHODECTIDÆ.

Characters of the single genus.

Genus *Trichodectes*. Infesting mammals; tarsi with one claw; antennæ 3-segmented, in some species differing in the sexes; legs thickly beset with hairs; female with a pair of bent appendages on the sides or ventral surface of the eighth abdominal segment.

Family PHILOPTERIDÆ.

Infesting birds; tarsi with two claws; antennæ 5-segmented, not lying in an excavation on the under side of the head, but always projecting far beyond the sides of the head.

Genus *Docophorus* Nitzsch. (Plates iii and iv.) Body short and broad, head usually as wide across the temples as long, front broadly truncate or convex or slightly concave, rarely with a curving emargination; clypeus

with distinct suture, often with a broad uncolored anterior and lateral margin; signature usually shield-shaped, with acuminate posterior angle; prominent movable trabeculæ reaching to or beyond end of the first antennal segment; antennæ similar in the sexes, with thick first segment, segment 2 the largest, and segments 3-5 subequal. Thorax with meso- and meta-segments completely coalesced; legs rather flattened, insertions approached; front legs smallest and usually concealed beneath the head. Abdomen usually oval, of nine segments of about equal length; last segment of male rounded, of female small and emarginated. Color and markings whitish on buffy ground, markings clear light brown to opaque dark brown, and even to black; head with antennal occipital bands; thorax with lateral borders; abdomen with lateral bands, darkest, and lateral transverse blotches, longest in male where they nearly meet on the median line. This genus has been found on birds of all the larger groups except the Gallinæ.

Genus *Giebelia* Kellogg. (Plate xi.) General characters of *Docophorus*; forehead (labrum?) with a broad transparent membranous flap extending across the ventral surface of head and projecting conspicuously beyond lateral margins of head in the male and but slightly in the female; rectangular anterior angles of temporal region with large eye in the angle. Found, as yet, only on the genus *Puffinus* (Shearwaters).

Genus *Nirmus* Nitzsch. (Plates v and vi.) Body usually narrow and elongate, though not actually long, the species rarely exceeding $3\frac{1}{2}$ mm. in length; the antennæ similar in the sexes; clypeal suture ordinarily indistinct; the trabeculæ wanting, or if present very small, inconspicuous and not movable (rarely large and feebly movable); other characters approximately those of *Docophorus*. Found on all kinds of birds.

Genus *Akidoproctus* Piaget. Body slender, elongate, Nirmoid in general shape; front of clypeus with a deep median rectangular notch, clypeal suture not distinct; antennæ similar in the sexes, situated distinctly before the middle of the head, short; prothorax rectangular, meso- and metathorax fused, widest (except in one species) in front; abdomen with broad sutures and a longitudinal median uncolored line; slightly mesad of the lateral band there runs parallel with it on each side a second narrow transparent lateral band; the two last segments in both sexes abruptly narrower than the seventh and conical. But four species belonging to this genus have been described.

Genus *Eurymetopus* Taschenberg. (Plate xi.) Body broad, *Docophorus*-like; antennæ differing in the sexes; clypeus broad, truncate; anterior angles of antennary fossæ produced and pointed; metathorax short, broad, without indication of constriction between meso- and meta-segments; coxæ not projecting beyond lateral margins of thorax; posterior segment of abdomen broadly round with slight rounding emargination, deeper in female than in male. But three species of this genus are yet known, of which one is so aberrant that it should probably be made the type of a new genus.

Genus *Goniodes* Nitzsch. Body large and broad; head usually with temporal margin and outer occipital margin angulated; head often varying in form in the sexes; antennæ differing in the sexes, third segment of male always with appendage, first segment enlarged and sometimes with appendage; prothorax usually trapeziform, metathorax much larger, rounded laterally; abdomen usually broadly oval, lateral band broad. Color usually whitish or pale yellowish, the blotches tawny, the bands dark brown to black. Found only on Gallinaceous birds.

Taschenberg has given sub-generic names to certain pretty distinctly separable groups of species. These sub-genera may be distinguished by the following table:

- A. With rounded temporal and occipital corners. No appendage on third segment of male, or a very small one. *Stronglyocotes.*
- AA. With angulated temporal and occipital corners.
 - B. Antenna of male with segments 4 and 5 very short, third segment with appendage. Temporal angles weak. *Coloceras.*
 - BB. Segments 4 and 5 of male antenna of ordinary size. Temporal angles distinct.
 - C. Segment 3 of male antenna with appendage; segment 1 long and thick and sometimes with appendage. *Goniodes s. str.*
 - CC. Segment 3 of male antenna without appendage (distal angle slightly produced); segment 1 without appendage. *Rhopaloceras.*

Genus *Goniocotes* Burmeister. General characters those of *Goniodes*, but usually smaller species, and with antennæ of male never appendaged; the antennæ differ but little in the sexes, the male sometimes having the first and second segments larger than in the female. The species of this genus are found on gallinaceous and columbine birds.

Genus *Ornithobius* Denny. Body elongate, narrow; head broad, rather quadrangular; clypeus with a frontal emargination expanded within so that the bounding sides are pincer-like in shape, the points almost meeting, thus nearly inclosing the emargination; the antennæ arise far in front of the middle of the head, and differ in the sexes; the antennæ of the male have the first two segments larger than the others, and the third, which is diagonally truncated and expanded distally, is with or without an appendage; the abdomen has two parallel lateral bands on each side, and the last segment of the male is pointed, of the female rounded or truncate. Only three species of this genus have been found, all on swans.

Genus *Bothriometopus* Taschenberg. Body elongate,

sides subparallel; head about as long as wide, with swelling rounded temples; clypeus including most of the forehead; without antennal bands, and with a deep angular frontal emargination or notch (much as in *Akidoproctus*); antennæ situated in front of middle of head and differing in the sexes; the antenna of male long, first segment thickened and as large as all the others together and with a pointed projecting process; antenna of female short, first two segments of equal length; legs very long, abdomen of both sexes with posterior segment 2-pointed behind. But one species has been described, taken from *Palamedea*.

Genus *Lipeurus* Nitzsch. (Plates vii, viii, ix and x.) Body long, slender; head usually narrow, elongate, with rounded temporal margins; clypeus usually with distinct signature, and with distinct or indistinct suture; antennæ differing in the sexes, the male antenna with first segment long and thick, rarely with appendage; third segment has an appendage, which is sometimes small and inconspicuous; the female antenna is simply filiform with first segment the thickest and second segment the longest; metathorax usually at least twice as long as the prothorax, often showing a lateral constriction indicating the line of fusion of meso- and meta-segments; the legs arise far apart, the proximity of the coxal cavities of the second and third pairs of legs to the thoracic margins being one of the diagnostic characters of the genus; the coxæ are long and project conspicuously beyond the lateral margins of the thorax; abdomen elongate and narrow, with segments 8 and 9 fused. Body color, white to brown, with conspicuous markings of pale brown to black. There are many described species and they have been found on all kinds of birds, being especially common on swimmers and rare on passerine birds.

Genus *Oncophorus* Rudow. (Plate xi.) (The generic name *Oncophorus* was proposed by Rudow for a species which has since been transferred to another genus, *Eurymetopus*, but Piaget, retaining the generic name, has grouped under it a number of species presenting the characters following. This genus "*sert de transition naturelle entre les genres Docophorus et Nirmus d'une part et les genres Goniodes et Lipeurus d'autre part.*") Usually small, 2 mm. being a maximum length among the known species; varying from broad to slender; head conical, clypeus with or without distinct suture, with or without signature; antennæ differing in the sexes, the male antenna longest, and the first three segments with or without appendages; prothorax but little shorter than the metathorax; legs short like those of *Nirmus*; color generally dark brown. But few species (eleven) so far described.

Suborder AMBLYCERA.

With the antennæ clavate or capitate, 4-segmented, and with filiform 4-segmented labial palpi.

Family GYROPIDÆ.

Characters of single genus.

Genus *Gyropus* Nitzsch. Infesting mammals, tarsi with one claw; temples produced into angulated processes; mouth parts on the frontal margin of the head; size, small from .7 to 1.2 mm.

Family LIOTHEIDÆ.

Infesting birds (see *Boopis*!); tarsi with two claws; the 4-segmented antennæ lying, when not outstretched, in an excavation on the under side of the head.

Genus *Colpocephalum* Nitzsch. (Plate xii.) Body varying in size from very small (1 mm.) to large (3 mm.), elongate, oval or elliptical; head usually wider than long

with distinct ocular emargination; eye located in the posterior portion of the emargination, simple or semi-divided by an emargination; temples usually swollen or "winged" with rounded or nearly straight lateral margin; just behind the eye and along the anterior margin of the temple a series of fine short hairs, the "ocular fringe"; the 4-segmented labial palpi extending beyond the lateral margins of the head; the 4-segmented antennæ with first segment short, cylindrical, second, conical, truncated, third goblet-shaped, fourth cylindrical or ovoid usually obliquely truncated; prothorax usually longer than metathorax, with produced lateral angles and bearing a pale or uncolored transverse line which does not extend into the lateral angular regions; mesothorax indicated by a slight constriction and sometimes by an uncolored transverse line across the metathoracic segment; first segment of tarsus short, with a small flat lobe or plate, second very long and slender; abdomen with nine segments, the posterior one differing in the sexes, with distinct dorsal and ventral posterior borders. Color whitish or yellowish with pale to dark brown markings. The genus contains many species, found on all birds except ostriches.

Genus *Boopia* Piaget. The single species upon which this genus is established by Piaget was found by him in company with individuals of *Colpocephalum truncatum* on *Phascodomys fessor*, a wombat! Can these true Liotheid forms have been stragglers from some bird host to this mammalian host? The characters of the genus, as shown by the one species, are: Body about 2 mm. long; head rounded in front, ocular emargination wide but shallow, situated more anteriorly than in other Liotheidæ; eye hemispherical, very large, located in the anterior portion of the ocular emargination; temples angularly produced; the palpi passing the margins of the head by three seg-

ments; the antennæ with second segment subspherical, third pedunculated, fourth the largest; thorax much as in *Colpocephalum*; legs, long and hairy; abdomen of eight (?) segments. The middle of the head and borders of the abdomen yellowish; the rest of the head, thorax and abdominal blotches tawny.

Genus *Trinoton* Nitzsch. (Plate xiii.) Body large, from 2 to 6 mm. long; head, triangular, with rounding angles, with projecting rounded temples, and convex arcuated occipital margin; antennæ, short and concealed, palpi projecting beyond lateral margins of forehead; eye prominent and emarginated, appearing double; the whole thorax very long, in one species larger than the abdomen; mesothorax separated from metathorax by distinct suture (the diagnostic character of the genus); legs long, strong and haired; first segment of tarsus short, with two narrow and acute lobes, second long with two small lobes near the extremity; abdomen elongate oval, nine segments, the posterior segment being rounded behind in the female and trilobed in the male. Color whitish, with brown or reddish brown blotches and black bands.

Genus *Læmobothrium* Nitzsch. (Plate xiv.) Large species, from 5 to 10 mm. long; body elongate, rather slender; head usually longer than wide, truncate or emarginate in front; temples but little swollen with occipital corners angulated; occipital margin deeply concave, with a neck-like prolongation; a large and distinct oral fossa; the mesothoracic suture obsolete, although usually faintly indicated; metathorax separated from abdomen by distinct suture, but of general appearance of an abdominal segment; legs long and strong; first segment of tarsus short with a large lobe; second segment very long and without lobes; abdomen elongate, tapering posteriorly; the ninth segment rounded or truncate. Color varying

from tawny to blackish brown on a whitish ground. Found on birds of prey, and certain water birds.

Genus *Physostomum* Nitzsch. Species large, from $2\frac{1}{2}$ to 5 mm. long; body elongate; head broadly conical, straight or a little concave on the lateral margins, without ocular emarginations; broad and usually truncate or flatly convex in front; temporal corners angulated; the under side of the forehead with two small motile muscular lobes projecting slightly beyond the lateral margins, characteristic marks of the genus; palpi prominent; antennæ very short, always concealed in their furrows; thorax longer than the long head; meso- and metathorax completely fused, the posterior width of the metathorax same as anterior width of first segment of abdomen; legs robust, little colored and with few hairs; first segment of tarsus with a small double lobe; second segment rather short. Abdomen elongate elliptical, ninth segment broad and rounded. Color clear pale brown to yellowish, abdomen with lateral bands. The species are few and have been found as yet exclusively on passerine birds.

Genus *Eureum* Nitzsch. Body large, head and abdomen very wide, and metathorax very short; head without ocular emargination and with temples very much enlarged and rounded; antennæ concealed in their cavities; the palpi never projecting beyond lateral margins of the head; thorax about same length as the head; prothorax concave before and behind; the shorter metathorax of the same form as first segment of abdomen; legs long, second segment of tarsus very long; abdomen with acute posterior angles of segments, and hairy. But two species are known, one found on a swallow and the other on the chimney swift.

Genus *Nitzschia* Denny. Body of medium size, about 2 mm. long; head with small ocular emargination, and a

slight but distinct emargination of the lateral margin in front of the ocular emargination, being about where the projecting palpi pass the margins of the head; head wider than long, temples expanded and angulated in front and behind; antennæ short and entirely concealed in their cavities; palpi rather long and projecting beyond margins of the head; prothorax hexagonal with obtuse angles; the mesothoracic suture slightly indicated on the lateral margins; legs long and only slightly colored, first tarsal segment very short with a small acute lobe, second segment larger; abdomen similar in the sexes, obovate, widening posteriorly, with broad lateral bands. Color tawny, blotches ferrugineous, and lateral bands dark reddish brown. Only one species certainly known; found only on the chimney swift.

Genus *Ancistrona* Westwood. (Plate xiii.) Body very large, 6 mm. long and $2\frac{1}{2}$ mm. wide; head crescentic, without ocular emargination; with two 2-pointed strongly-chitinized processes on ventral aspect of hind head projecting backward beyond occipital margin of the head; antennæ concealed in ventral cavities; the lateral palpi short. Prothorax as large as the head; the metathorax like an abdominal segment; the coxæ of the front legs bear a long appendage or lobe; abdomen of ten segments. Only a single species certainly known; found on the Fulmars.

Genus *Menopon* Nitzsch. (Plates xiv and xv.) Body small to large, varying from 1 mm. to 5 mm. in length; of general shape and character of *Colpocephalum* (from which it is sometimes hardly distinguishable), but the ocular emargination is wanting or is slight; an ocular emargination is often present and plainly visible inferiorly, but superiorly there is a membrane which extends across it; head always widest across the temples; the antennæ

short, first two segments truncated, conical, the second rarely with a short appendage, the third usually pedicelated and goblet-shaped, receiving the spherical or ovoid or cylindrical fourth into this open mouth; the fourth is always the largest of the four segments; mesothorax fused with metathorax; legs long, first segment of tarsus very short with a lobe of variable form, second long with a small chitin plate often swollen at its extremity; abdomen differs in the sexes, both as to general form and specially as to the last (ninth) segment; posterior border of ninth segment of female fringed with fine hairs which are not present in male. Color whitish or yellowish with darker markings. This is a very large genus, infesting all kinds of birds.

TERMINOLOGY.

By means of the following definitions and accompanying figures the student will be enabled to understand, it is hoped, the special descriptive and structural terms used in the synopses, keys and descriptions of Mallophaga. Most of these terms are the English equivalents, as nearly as possible, of the terms used in the French and German monographs. A few of them are here first used.

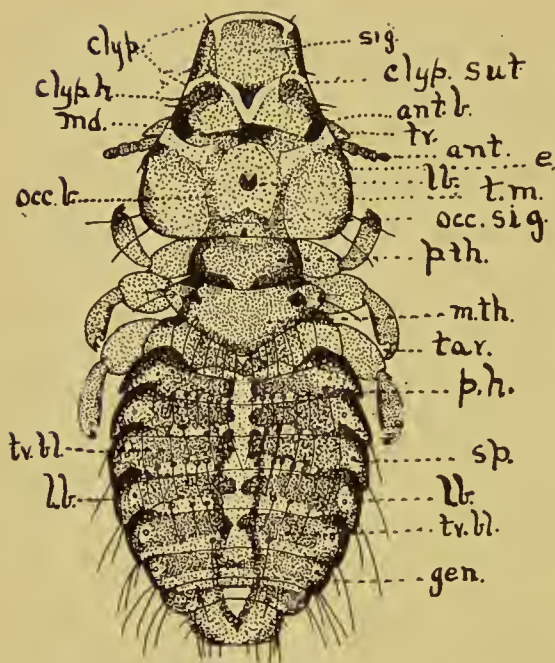


Fig. 1. *Docophorus fuliginosus* Kell., male; *clyp.*, clypeus; *clyp. sut.*, clypeal suture; *clyp. h.*, clypeal hair; *sig.*, signature; *md.*, mandibles; *ant.*, antenna; *tr.*, trabecula; *e.*, eye; *occ. b.*, occipital band; *ant. b.*, antennal band; *lb.*, chitinized part of labium; *occ. sig.*, occipital signature; *pth.*, prothorax; *mth.*, metathorax; *tar.*, tarsus; *p. h.*, "pustulated" hairs; *tr. bl.*, transverse blotch; *l. b.*, lateral band; *sp.*, spiracle; *gen.*, genitalia.



Fig. 2. *a*, antenna of *Lipeurus baculus* ♂; *b*, antenna of *Lipeurus ferox* ♂.

CLYPEAL SUTURE, or, in descriptions of the head, the *suture* (*clyp. sut.*, fig. 1). The distinct or indistinct suture separating the clypeus from the rest of the head; when distinct, appearing as a narrow uncolored line; when indistinct, usually recognizable on the lateral margins of the head by a small emargination.

FOREHEAD That part of the head in front of the mandibles and antennæ.

ANTENNAL APPENDAGE (fig. 2). A projecting process on the first or third segments of the antennæ of the males of certain genera. This appendage may be simply a slight projection of one side of the distal extremity of the segment, or may be long and curving, and may arise from the middle of the segment.

ANTENNAL BANDS (*ant. b.*, fig. 1). Pale to dark-colored chitinous bands extending along the lateral margins of the forehead, interrupted and divided into two parts when the clypeal suture is distinct, sometimes divided into three parts (*Nirmi nigropicti*).

ANTENNARY FURROWS (*ant. f.*, fig. 3). The furrows on ventral aspect of head of members of the Liotheidæ in which the antennæ lie, concealed from dorsal view.

CLYPEAL HAIRS (*clyp. h.*, fig. 1). Usually short, fine hairs on the margins, frontal and lateral, of the clypeus.

CLYPEUS (*clyp.*, fig. 1). That part of the head in front of the clypeal suture; prominent throughout the group.

GENITAL BLOTCH. Abdominal markings on the under side of the last segments of the female; sometimes single and median, sometimes paired and lateral.

GENITALIA (*gen.*, fig. 1). The colored chitinized parts of the genitalia, often showing through the surface of the body.

HIND-HEAD. That part of the head behind the mandibles and antennæ.

INTER-COXAL LINE (*i. c. l.*, fig. 4). A sternal marking consisting of a colored line or narrow band running transversely between two coxæ of the same side.

LATERAL BANDS (*l. b.*, fig. 1). The dark or transparent lateral margins of the abdomen.

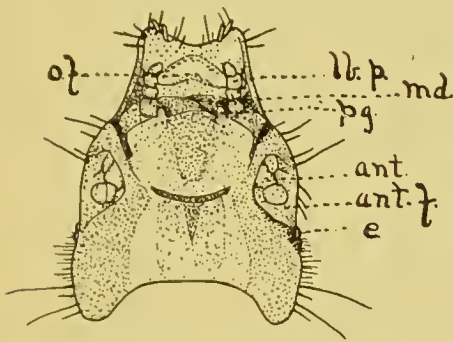


Fig. 3. Under side of head of *Læmobothrium similis* Kell.; *of.*, oral fossa; *lb. p.*, labial palpus; *md.*, mandible; *pg.*, paraglossa; *ant.*, antenna; *ant. f.*, antennary furrow; *e.*, eye.

LABIAL PALPI (*lb. p.*, fig. 3).

The 4-segmented labial palpi, present only among the Liotheidæ; usually projecting laterally beyond the lateral margins of the forehead.

METATHORAX (*m. th.*, fig. 1).

As the meso- and metathorax are in most genera of the order fused into a single segment; the term metathorax used when no mention is made of the meso-thorax is intended to apply to this compound segment.

OCCIPITAL BANDS (*occ. b.*, fig. 1). Pale to dark-colored chitinous bands extending from the occipital margin forward to the mandibular rami.

OCCIPITAL MARGIN. The posterior margin of the head.

OCULAR BANDS. Bands extending from the eyes to the anterior extremities of the occipital bands.

OCULAR BLOTCH. A colored blotch contiguous to the inner margin of the eye.

OCULAR EMARGINATION. An emargination of the lateral margin of the head, the eye lying in the emargination though near the posterior end of it.

OCULAR FLECK. A small intensely black spot of pigment in the eye.

ORAL FOSSA (*o. f.*, fig. 3). A furrow lying in front of the mandibles.

OCULAR FRINGE. A series of closely set small hairs on the posterior half of the inner margin of the ocular emargination and extending to and sometimes on the temporal margin; especially characteristic of *Menopon* and *Colpocephalum*.

PUSTULATED HAIRS (*p. h.* fig. 1). Hairs rising from uncolored (unchitinized) spaces.

SIGNATURE (*sig.*, fig. 1). A colored blotch on the clypeus, usually with a posterior acuminate point. The *occipital signature* is a usually sub-circular colored blotch on the under surface of the hind-head, often showing through above.



Fig. 4. Ventral aspect of thorax and first abdominal segment of *Nirmus prestans* Kell.; *cox.*, coxa; *i. c. l.*, intercoxal line; *m. bl.*, median sternal blotch; *m. bl. a.*, median blotch of abdominal segments.

STERNAL MARKINGS (fig. 4). Colored blotches and lines on the ventral aspect of the thorax.

TEMPORAL MARGINS (*t. m.*, fig. 1). The lateral margins of the hind-head.

TRABECULÆ (*tr.*, fig. 1). Two processes, one on each side of the head, projecting laterally from the anterior angle of the antennary fossa; largest and movable in *Docophorus*.

TRANSVERSE BLOTCHES (*tv. bl.*, fig. 1). The colored blotches, one on each lateral half of each abdominal segment.

COLLECTIONS MADE.

The specimens which I have had for study have been collected by me from newly-killed birds, or from freshly-made skins under the following circumstances:

(a) A collection made at Lawrence, Kansas, during the years 1889-1892, exclusively from newly-killed birds, the birds determined by me, and in most cases collected by me.

(b) A collection made by me at the Hopkins Seaside Laboratory on the shore of the Bay of Monterey, California, during the two weeks from Dec. 17, 1894, to Jan. 1, 1895, from newly-killed birds and from the fresh skins lying in cotton forms on tables in the laboratory; the birds were collected on the bay by Mr. Leverett M. Loomis, Curator of Birds of the California Academy of Sciences, and were determined by him.

It will always be of interest to the student of these parasites to know the exact conditions attending the col-

lection of any set of specimens in order that he may weigh fairly the probable accuracy of the host determinations and the value of any statements as to relative abundance of the individuals of a species, or of the constant or casual occurrence of any parasite species on the individuals of its host species.

A large number of the specimens upon which the monographs of the order are based were collected from the dried skins of birds in various museums. Piaget has found the museum of Leyden a fertile field for collecting. But it is evident that collecting under such circumstances makes uncertain any generalization regarding the abundance of individuals on the host, and the constancy of occurrence of any certain parasite species on any certain bird species. There is also much likelihood of "straggling" and little opportunity to prove or disprove it. On the other hand, in collecting from the newly-killed birds one can practically determine the total parasitic fauna of any bird specimen; and, where a large series of specimens of one bird species is obtained, definite conclusions as to the constant or casual occurrence of a parasite species upon its host can be attained. The collection of immature specimens is practically restricted to collectors from newly-killed specimens because the tender, unchitinized body of the young insect shrivels soon after death; thus the immature insects are rarely found on dried skins. This may account for the absence of references in the European monographs to the immature stages of any of the described species.

METHODS OF COLLECTING AND PRESERVING.

The methods of collecting are simple. The parasites do not leave the body quickly after the death of the host, so if there is no opportunity to take them from the host in the field immediately after shooting, they may be col-

lected after the dead birds are brought to the laboratory or museum. Most of my collecting has been done in connection with the collection of the birds for museum purposes. The parasites frequent all parts of the body of the host, but after death of the host are especially to be sought about the lores and base of the bill. Here they seem to congregate, and while sometime after death of the host many parasites leave the body others will stop their traveling at the base of the bill, and rather than leave the body will fasten themselves by claws or mandibles to the short stiff feathers of this region and die there. The death of the parasites which remain on the body after death of the host takes place in from four or five hours to seven days. In most cases all of the parasites are dead at the end of two or three days. It is evident, in face of the fact that after death of host many parasites leave the body, that much care must be taken to prevent "straggling," i. e., parasites from one bird getting upon some other bird which may be conveniently near. In the game-bag each bird should be well wrapped in paper, or, as is common with collectors, placed in a paper cone head downwards.

In addition to the examination of newly-killed birds, the examination of freshly-made skins may be made, or even of old and dry skins. On these skins the dried bodies of the dead insects, their external appearance (in case of adults) little modified because of their firm chitinous covering, may be found attached by the mandibles to the feathers.

The collected insects should be kept in alcohol in vials. I put all of the parasites taken from one bird specimen in a single vial, giving this vial an accessions number and putting into it a label bearing name of locality, date and name of bird. Later, with opportunity, the specimens

in any one vial may be assorted into species putting each species in a vial by itself and giving this vial the same accessions number as the original vial and in addition a sub-number or letter. In my catalogue of accessions there are entered under each accessions number the sub-numbers or letters with specific name of the parasites when determined. By this plan, any specimen of parasite can be traced at any time to the individual bird from which it came, and statistics of abundance on the host, of number of individuals of a single species, or of the constant or casual occurrence of a parasite species on a host species can be compiled. Also, the parasitic faunæ of different specimens of the same bird-species from different localities can be critically compared.

The alcohol modifies the specimens but little; their hard chitin covering prevents appreciable shrinking, and the colors are due chiefly to the excess or scantiness of chitinization in different parts of the body, a coloration not much affected by alcohol. Specimens intended for dissection can be well preserved in soft condition in a five per cent. solution of chloral hydrate.

DESCRIPTIONS OF NEW SPECIES.

Docophorus calvus n. sp. (Plate iii, fig. 1.)

A single female, taken on a California Murre, *Uria troile californica* (Bay of Monterey, California).

Description of female. Body, length 1.7 mm., width .8 mm.; short, broad, small, with golden brown markings, darker on margins, almost without hairs.

Head, length .53 mm., width .56 mm., thus being slightly wider than long; conical, with uncolored frontal part of clypeus slightly expanded and feebly emarginate; suture distinct; lateral margin of head in front of suture slightly concave; temporal margins convex with two hairs, and

one hair in the prominent eye; occipital margin straight; trabeculæ large; signature colored, posterior margin with darker-colored acuminate point, anterior margin parallel with front margin of clypeus, i. e., emarginate; antennal bands distinctly colored and continued in front of suture, and bending in at posterior ends; behind these bent-in ends a diagonally transverse, uncolored line; occipital bands distinct; temporal margins colored.

Prothorax small, short, much narrower than the head; angled behind, with a slight, rounding prominence at posterior lateral angles bearing a single hair; colored, paler in the center. Metathorax short, angled behind, with sides produced and obtusely rounded, bearing one long hair; whole segment strongly colored.

Abdomen broadly elliptical; first segment wholly colored, segments 2-7 with a strong lateral blotch, irregularly triangular, pointed inwardly, with clear stigmal spot, with uncolored posterior angles, and with one or two hairs arising from extreme posterior lateral point of colored blotch; eight segment wholly colored; ninth uncolored, rounded, with only very small hairs; central space of abdomen uncolored; a rectangular genital blotch with backward projecting posterior angles showing through on sixth and seventh segments.

***Docophorus fuliginosus* n. sp.** (Plate iii, fig. 2.)

A few specimens from a Black-bellied Plover, *Charadrius squatarola* (Lawrence, Kansas), and a single male from a specimen of the same bird-species shot near Palo Alto, California. The new species belongs to the group *rotundati* (with convex or truncate clypeus) of Piaget's super-group *latitemporales*, which includes the *Docophori* of the shore birds. This group closely resembles the group *pustulosi* of the Terns, and this species from *Chara-*

drius very closely resembles the common *melanocephalus* of the Terns.

Description of the male. Body, length 1.62 mm., width .65 mm.; head and thorax smoky golden brown, abdomen dark brown with black markings.

Head, length .60 mm., width .53 mm.; front convex with a narrow uncolored border, and a short hair in each anterior angle; one short, marginal hair in front of the distinct suture, and two behind it; trabeculæ medium; eye inconspicuous, with a short hair; temporal margins with two hairs; occipital margin straight, bare; signature shield-shaped, pale, with acuminate posterior point darker colored; quadrangular space in anterior part of signature slightly darker colored than rest of signature; angulated antennal bands, their continuations in front of the suture as narrow marginal borders, the diverging occipital bands and the marginal temporal borders dark brown; also a narrow occipital border not extending to the sides of the head and interrupted medially.

Prothorax, short, with slightly diverging sides and flatly convex posterior margin; posterior angles with a single hair; color smoky golden brown, with a dark brown lateral border, extending around the posterior angles, and a little way along the posterior margin. Metathorax short, broad, with widely diverging short sides, and broadly parabolic posterior margin thickly set with a series of pustulated hairs. Sternal markings consisting of dark brown intercoxal lines, a pale median prothoracic blotch, and a small, pale, triangular metathoracic blotch. Legs, fuliginous with narrow dark brown to black markings.

Abdomen, broadly ovate, turbinated; segment 2 with specially prominent, acute, projecting, posterior angles; segments 4-8 with one to two hairs in posterior angles;

whole abdomen, except segment 9, strongly colored; segments 2-7 with broad black lateral bands; segments with long, transverse, dark brown blotches barely separated medially by an uncolored line, widest on second segment and narrowing on each successive segment; transverse blotches confluent medially on segment 1, with a small, medial, angulated, uncolored emargination on anterior margin; segments 2-5 with a series of pustulations along posterior margin of each transverse blotch, and behind each series a narrow dark brown transversal line; segment 1 with but two demi-pustulations near mesal end of each transverse blotch; segment 9 with uncolored anterior angles, and a lateral smoky brown blotch with four or five short pustulated hairs; posterior margin truncate with a few rather short hairs; genitalia extending through segments 3-9.

Female, length 2. mm., width .9 mm.; head, length .65 mm., width .65 mm.; transverse blotches of abdomen, except of segment 1, not closely approached mesally; segments 1-6 with series of pustulated hairs along posterior margin of transverse blotch, four hairs in segment 1, six hairs in segments 2-6; blotches on segments 2-5 acute mesally, blotches of segment 6 diagonally truncate, and of segment 7 flatly rounded; a narrow transversal line between succeeding blotches of each side of abdomen; segment 8 wholly colored, with a narrow transverse line running across segment close to and parallel with anterior margin of blotch; posterior margin convex with four hairs.

Docophorus graviceps n. sp. (Plate iii, fig. 3.)

A single male specimen, taken from an American Coot, *Fulica americana* (Bay of Monterey, California); and two females from a Pacific Loon, *Urinator pacificus* (Bay of Monterey, California).

Description of male. Body, length 2. mm., width .72 mm.; pale golden brown, with characteristic angulated, black, lateral abdominal markings; abdomen Nirmoid, head large and just as broad as long.

Head, length .62 mm., width .61 mm.; broadly conical; clypeus with uncolored, truncated, frontal margin, and rounded angles; a very fine short pair at middle of each rounded anterior angle, and one at the suture; temporal margins with one short prickle and three long hairs; eye with a short hair; trabeculæ broad, acute-angled; antennæ short, thick; signature pale smoky brown, broadly hexagonal; posterior margin slightly rounding; on each side of the signature a similarly colored elongated triangular blotch apex anteriorly; ground color of head pale golden brown with darker mandibles, broad curving antennal bands, narrow temporal margin, and occipital bands convex outwardly; occipital margin straight.

Prothorax, short, broad, a single short hair in posterior angle, and anterior margin deeply emarginated and projecting under the head; broad lateral margins and forward projecting anterior processes dark brown. Metathorax, short, broad, with rounding lateral margins; with a short prickle at rounding anterior angle, a short prickle and long hair in middle of side, and one long and two short hairs at rounding posterior angle; posterior margin slightly convex on abdomen.

Abdomen, long, ovate, with obtuse posterior angles of segments projecting along lateral margin, the angles of segments 1-6 bearing a single hair, 7-8 with two hairs; first segment with brown triangular blotch in anterior angles, segments 2-7 with brown transverse blotches covering almost entire segment; along lateral margins on each segment a sharp blackish angulated line extending forward into preceding segment; inside of this broken

marginal line the stigmatal series, and still inside a faint continuous uncolored line; transverse blotch on segment 8 curving, and the lateral line narrow and sinuous; segment 9 but weakly colored; the genitalia extending forward into the eighth segment, and with distinct small claws at posterior end.

The female specimens were so distorted in preparation as to preclude any careful description. The ninth segment is small but distinct, feebly and broadly emarginated, and has two lateral triangular pale brown blotches. The general abdominal markings similar to male, the characteristic angulated black lateral lines being present.

Docophorus acutipectus n. sp. (Plate iii, fig. 4.)

A single female taken on the Rhinoceros Auklet, *Ceratorhina monocerata* (Bay of Monterey, Cal.) This species resembles *D. celedoxus* Nitzsch, taken on *Alca torda*, *Uria troile* and *Fratercula arctica*, but differs in the absence of sternal markings, the almost failing emargination of the clypeus, the character of the genital blotch of the female, and in the larger size.

Description of female. Body, length 1.94 mm., width .7 mm.; golden brown with darker markings, middle space in abdomen whitish.

Head length .56 mm., width .56 mm.; general markings and shape of *celedoxus*; front of clypeus with very faint emargination, one short marginal hair and another just in front of suture; trabeculæ large, obtuse, reaching to middle of second segment of antenna; antennæ with short thick first segment, second segment longest, bearing a short dorsal hair, third and fourth short, equal, fifth longer; temporal margin with two hairs, eye with a short hair, occipital border straight; signature pale smoky brown, long, with posterior acuminate point, darker colored; suture distinct; dark brown antennal bands, con-

tinuing in front of suture, behind it angularly curving; occipital bands diverging, and separated from antennal bands by an uncolored line.

Prothorax short with lateral margins obtusely angulated and bearing one hair in angle; broad lateral colored border, anterior border colored, median uncolored space. Metathorax obtusely angled laterally, long and acutely angled on abdomen, three hairs in margin behind lateral angle, broad lateral borders colored. No sternal markings. Legs concolorous with body.

Abdomen elongate ovate; first segment wholly colored except for distinct narrow median uncolored line not reaching quite to posterior border of segment; segments 2-7 with lateral blotches, on segments 2-5 pointed within, on segments 6-7 blunt within; each blotch with stigmal spot and several wholly or partly enclosed small circular clear spots along posterior margin; segment 8 longer and wholly colored, segment 9 short with two lateral flecks; genital blotch of under side with frontal transverse bar, and extending backward two pointed elongate triangular spaces, lateral ends of the transverse bar diagonally truncate.

Docophorus quadraticeps n. sp. (Plate iii, fig. 5.)

A male and a female taken from an American Coot, *Fulica americana* (Monterey, California). This species closely resembles *kansensis*, taken from an American Eared Grebe, *Colymbus nigricollis californicus* (Lawrence, Kansas). It differs from it by its larger size, the more rotund abdomen, in the distinctly long acuminate signature, and less markedly in the genital blotch.

Description of female. Body, length 1.87 mm., width .87 mm.; short golden brown with narrow dark margins of thorax and anterior half of abdomen, and short triangular abdominal blotches with few large pustulations.

Head, length .6 mm., width .6 mm.; broadly conical, forehead especially broad; front truncate with a hair on dorsal surface in rounded anterior angle, projecting forward behind the hair two very short ones (not marginal, and showing through from underside), and behind them a very long hair; at suture a short marginal hair, and behind the suture two curving hairs on dorsal surface near the margin and projecting beyond the margin; trabeculæ large, broad and colored at base with rapidly tapering uncolored tip; antennæ, weakly colored, first segment thick, second segment slender as long as first segment, third, fourth and fifth short and about equal; temporal angles with three long pustulated hairs, also a marginal hair just behind the eye and a long one in the eye; occipital margin slightly convex in the middle and slightly concave each side of the middle; signature pale, broad, truncate anteriorly and with long, acuminate, darker colored tip projecting beyond the mandibles; antennal bands pale, interrupted by the distinct clypeal sutures, and coalescing with the much darker, conspicuous, widely diverging occipital bands; temporal margins narrowly edged with black.

Prothorax short with rounding angles, posterior margin flatly convex and a single long pustulated hair behind the posterior angles; lateral margins with even black borders bending inwards, narrowing and paling on posterior margin. Metathorax broadly pentagonal, posterior margins thickly set with a line of long pustulated hairs; lateral margins unevenly bordered with dark brown and black, broadest in lateral angles. Legs smoky with darker markings, and uncolored extremities of tibiæ, tarsi and claws.

Abdomen ovate, with several long marginal hairs in posterior angles of segments; segments 1-7 each with a

lateral, brown, triangular blotch, with an outer, marginal, narrow, blackish line contiguous to the anterior margin of the segments, but leaving an uncolored space about one-third the length of the segment between the hind margin of blotch and posterior margin of segment; each segment with a single transverse series of long hairs pustulated along the posterior margin of the triangular markings, but not pustulated in the median, uncolored portion of the segment; a conspicuous, clear, stigmal spot in each blotch; triangle of first segment extending furthest inwards (nearly to median line), and shorter on each succeeding segment; eighth segment wholly colored; ninth segment uncolored, short and emarginated; a large, broadly crescentic, genital blotch with a median, angulated projection in posterior concave border on ventral face of segments 6-7.

Male, length 1.5 mm., width .4 mm.; head, length .53 mm., width .5 mm.; abdomen short, broadly ovate, with triangular blotches prolonged inwardly; ninth segment flatly rounded behind with a few rather long hairs.

Docophorus montereyi n. sp. (Plate iii, fig. 6.)

Abundant on the Ancient, Marbled and Aleutian Murrelets, *Synthliborhampus antiquus*, *Brachyrhampus marmoratus* and *Ptychorhampus aleuticus* (Bay of Monterey, California). Specimens were taken from forty-six individuals out of fifty-five birds of these species shot.

Description of male. Body, length 1.56 mm., width .53 mm.; head large, pale golden brown, abdomen dark, thorax and abdomen with black lateral border.

Head, length .47 mm., width .43 mm.; uncolored front of clypeus very slightly expanded, rounded with a single marginal hair on the side in front of the suture; trabeculae large reaching almost to the middle of the second antennal segment; antennae with first segment thick and about as long as second, third and fourth very short, equal,

fifth longer than third or fourth; eye with short curving hair; temporal margins with two hairs; occipital margin straight, even slightly convex noticeable at least medially; color pale smoky brown; signature shield shaped with produced acuminate posterior angle not reaching the mandibles, darker colored; antennal bands dark brown, distinct, posterior ends turning diagonally inwards, anterior ends where interrupted by the suture turning in toward the base of the point of the signature, and tapering to an acuminate point; occipital bands dark brown, narrow, uniform, widely diverging, and separated from the antennal bands by a pale diagonal space; region immediately contiguous to the eye dark brown.

Prothorax short, broad, sides diverging, a single long hair in posterior angles; hexagonal, the middle third of the posterior margin making a very obtuse but distinct angle with the lateral thirds; a broad, uniform, dark brown to black border on the lateral margins and lateral thirds of the anterior and posterior margins. Metathorax with sides rapidly diverging; posterior margin with rounding angle on the abdomen, and a series of about fourteen pustulated hairs ranged along its entire length from lateral angle of one side to lateral angle of the other side; lateral margins bordered with dark brown to black; an anterior medial region almost uncolored; rest of segment fuscous. Legs concolorous with head and prothorax, with darker markings.

Abdomen short, suborbicular, turbinate, hinder segments with one to three longish hairs in posterior angles; segment 1 wholly colored, fuscous, with the blotch angulated medially on posterior margin and emarginated narrowly on anterior margin; remaining segments except the last with a long, lateral, transverse, fuscous blotch preceded by an equally long, transverse, fuscous line,

these blotches and lines black along lateral margin of body forming broad, black, lateral, abdominal bands; the blotches and lines separated medially by a pale, almost uncolored space on segments 2-5; on segments 6-7 and on posterior half of segment 5 the blotches and lines coalesce on the median line; several pustulated hairs ranged along posterior margins of blotches on segments 2-6; last segment flatly rounded posteriorly with several longish hairs, a curving, transverse, medial blotch, and regions of the anterior angles uncolored.

Female, with transverse blotches of segments 2-7 of abdomen very short, beginning with anterior segments successively acute, diagonally truncate, and truncate on inner ends, the usually three pustulated hairs conspicuous; large medial space of abdomen whitish; last segment fuscous, with five longish hairs in two groups, one of two and one of three, on each side; measurements, length 1.75 mm., width .7 mm.; head, length .53 mm., width .51 mm.

***Docophorus occidentalis* n. sp.** (Plate iii, fig. 7.)

An abundant species on the Pacific Coast varieties of the Fulmar, *Fulmarus glacialis pacificus* and *F. g. rodgersii*; found on twenty-nine of thirty of these Fulmars shot on the Bay of Monterey, California. Two specimens, probably stragglers, taken on two Surf Scoters, *Oidemia perspicillata* (Bay of Monterey).

Description of the male. Body, length 1.56 mm., width .7 mm.; short, broad, strongly-colored, with black abdominal bands and triangular, lateral, abdominal blotches.

Head, length .53 mm., width .53 mm.; conical, with truncate or weakly convex front; three very small marginal hairs, one of which is slightly in front of suture; trabeculae reaching slightly beyond base of the second antennal segment; antennae colored except at sutures,

second segment longest, third, fourth and fifth segments about equal; temporal angles with two hairs; eyes with a short spine; occipital margin straight or slightly convex; signature broadly shield-shaped, constricted near the front, anterior margin truncate or slightly emarginated, posterior margin with a darker colored obtuse angle; angulated antennal bands dark colored and specially distinct; occipital bands distinct, widely diverging, and interrupted by a diagonally transverse uncolored line; temples dark brown, narrowly margined with black; occipital margin between bases of occipital bands with border of same width and color as occipital bands, paler in the middle.

Prothorax short, broad with slightly diverging sides and rounded posterior angles, with one hair; with marginal lateral bands bending inwards along posterior margin. Metathorax pentagonal, angled on abdomen, with a series of seven pustulated hairs ranged along latero-posterior margins beginning at lateral angles; last hair of each series removed from others and near the posterior angle; segment mostly brown, with a dark lateral blotch in each lateral angle extending indistinctly along latero-anterior sides. Legs light brown, with dark brown markings. Sternal markings consisting of a short, broad, transverse line in front of the mesocoxæ, terminating inwardly in an expanded circular spot; a distinct, narrow, transverse, intercoxal line between meso- and metacoxæ, bending backward and margining narrowly the coxal cavity, and four small median spots, the hindmost of which is the largest.

Abdomen short, broadly ovate, segments 1-7 with elongate, narrow, brown triangles, with acute apex inwardly; each one of segments 2-6 with three pustulated hairs, one near the lateral margin of the triangle and two

near the apex, all along the posterior margin of the triangle; segment 1 with one pustulated hair near the middle, and segment 7 without hairs; segment 8 with narrow curving, transversal, nearly continuous brown band, and segment 9 wholly colored but paler; outer margin of each triangle broadly black, producing black lateral abdominal bands; posterior margin of segment 9 flatly rounded, with about ten longish hairs; segments 3-7 with one to three longish hairs in posterior angles; genitalia extending forward to third segment, and posterior pincer-like portion very strong.

Female. Body, length 1.8 mm., width .78 mm.; head, length .53 mm., width .53 mm.; pustulated hairs of metathorax at subequal distances apart; triangular blotches of abdomen not projecting so far inwardly, and with but two pustulated hairs; segment 8 wholly colored; segment 9 very small, uncolored, with two small lateral blotches, posterior end truncate, and with one short spine at each posterior angle; genital blotch on ventral face of segments 6-7, transverse anteriorly, with two posteriorly projecting pointed processes.

Docophorus kansensis n. sp. (Plate iii, fig. 8.)

A single female specimen taken from an American Eared Grebe, *Colymbus nigricollis californicus* (Lawrence, Kansas). The new form somewhat resembles *colymbinus* (Piaget, Les Pediculines, 1880, p. 117, pl. x, fig. 5, from *Colymbus septentrionalis*), especially in the shape and markings of the head; but the well-defined and characteristic abdominal markings are very different from the abdominal markings of *colymbinus*.

Description of female. Body, length 1.6 mm., width .64 mm.; pale golden brown, with darker, narrow, thoracic borders and short, lateral, triangular, abdominal blotches bearing a few, long, pustulated hairs.

Head, length .47 mm., width .44 mm.; broadly conical, front broad, slightly convex with a shallow median emargination; a hair arising from the dorsal surface near the obtuse anterior angle projects forward beyond the margin; behind this two short hairs (not marginal and showing through as in n. sp. a) and behind these a rather long hair; two short marginal hairs; trabeculæ long and rather slender, acutely-tipped; antennæ long; temporal angles with three hairs, also one hair just behind the eye, and one in anterior angle of eye; occipital border slightly convex; forehead much paler colored than hind head; signature short with slightly concave anterior margin and obtusely angled hinder margin; antennal and internal bands pale, temples and widely separated occipital bands darker.

Prothorax subquadrangular; rounded posterior angles with one hair; posterior border straight; distinct, regular, colored lateral borders. Metathorax pentagonal; with two non-pustulated hairs in lateral angle and five pustulated hairs ranged along each latero-posterior margin; uniform lateral colored border. Legs pale colored except tarsi and claws.

Abdomen, elongate ovate, without angulated lateral projections, with a few pustulated hairs on surface, and one or two rather longish hairs in posterior angles; segments 1-7 with lateral triangular blotch bearing three or four pustulated longish hairs ranged along posterior border of blotch; an uncolored stigmatal spot in each blotch; the lateral margins of segments 1 and 2 (less distinctly in 2) bordered with dark brown like the thoracic segments; segment 8 with transverse blotch extending entirely across the segment; and segment 9 uncolored or faintly colored, with slight emargination and only a few very short hairs.

Docophorus atricolor n. sp. (Plate iii, fig. 9.)

Not uncommon on the Ancient and Marbled Murrelets, *Synthliborhampus antiquus* and *Brachyrhampus marmoratus* (Bay of Monterey, California). This species is closely related to *colymbinus*.

Description of male. Body, length 1.75 mm., width .71 mm.; rather elongate, Nirmoid in shape, darkly colored all over with wide, black, lateral, abdominal bands.

Head, length .53 mm., width .6 mm.; slightly broader than long, front broad, with shallow rounding emargination, uncolored portion of clypeus slightly expanded, anterior angles rounding; one very short fine marginal hair at indistinct suture; trabeculae small; antennae short and slender; temporal margins with two long hairs; eyes flat with a spine; occipital margin concave; clypeal signature broad anteriorly, with truncate front margin, tapering slowly posteriorly to truncate, posterior margin reaching the mandibles; antennal bands darkly brown, right-angled, with posterior ends extending transversely inwards to mandibles; occipital bands distinct, slightly diverging and separated from forehead by a transverse, weakly colored, linear space behind antennal bands; temporal regions brown with margins darker.

Prothorax, small with anterior margin emarginated and projecting under the head; lateral and anterior margins distinctly and evenly bordered with dark brown to black, rest of segment brown; a short spine on lateral margin, and at rounded posterior angle a single hair. Metathorax short, broad, posterior margin flatly convex, angles rounded; a long hair and short spine in an uncolored space in front of middle of lateral margin, and three long hairs in posterior angle; segment wholly colored with darker, small, lateral, marginal blotch, in which is located the clear space containing hair and spine. Legs brown with darker markings.

Abdomen elongate, elliptical, segments short of about equal length; each segment with two weak median hairs on dorsal surface; whole colored dark smoky brown except tip of ninth segment; broad black lateral bands, connected on each segment by a narrow transverse black bar across middle of segment; on first segment this bar broader, covering nearly whole surface of segment, and with a narrow uncolored median line; ninth segment truncate behind with flatly rounded posterior angles; a series of short pustulated hairs along posterior margin; genitalia in segments 8 and 9, side pieces with a distinct toothed posterior claw.

Female, same size; not so dark; ninth segment emarginated for one-half its length, the points being obtusely angled, and with one very short hair each.

Docophorus insolitus n. sp. (Plate iv, fig. 5.)

A few specimens, male and female, taken from an Aleutian Murrelet, *Ptychorhampus aleuticus* (Bay of Monterey, California). This species was not found on other of the numerous individuals of the same bird species taken at Monterey.

Description of female. Body, length 1.65 mm., width .50 mm.; elongate, narrow, Nirmoid in general appearance, with long trabeculæ and distinct clypeal suture; color of head and thorax yellowish brown, abdomen whitish, with strongly marked dark brown bands of the head, borders of thorax, and blackish abdominal lateral bands, and brown transverse blotches.

Head, length .5 mm., width .4 mm.; large in comparison with total size of body, the head being nearly one-third of the total body length, elongate conical; that part of the head in front of the mandibles specially long; front broad, convex, with the margin finely crenulate; three small lateral marginal hairs on forehead; trabeculæ

large, blunt; eye with a short hair; temporal angles rounded, with two rather short curving hairs; occipital margin straight; bands of the head, viz., broad antennal, diverging occipital, distinct ocular reaching the tips of the occipital, and narrowly marginal, dark brown and well marked; pale brown signature large, with dark brown posterior angle not reaching mandibles and rather blunt.

Prothorax short, broad, with rounded angles and convex posterior margin; one hair in posterior angles; distinct dark brown lateral and anterior borders, also extending inwards from the posterior angles along the posterior margin, but not meeting; median space almost uncolored. Metathorax pentagonal, with rounding lateral angles and six hairs on each latero-posterior margin; broad lateral dark brown border, broadest in lateral angles. Legs concolorous, with pale brown tinge of body, tarsal claws darker.

Abdomen elongate, narrow, posterior angles of segment 2 produced, acuminate; lateral margins with two longish hairs, a few longish hairs on dorsal aspect; lateral bands semitranslucent smoky brown, composed of a series of slightly diagonal, narrow, marginal blotches, one on each segment, each blotch widest anteriorly, tapering posteriorly and not quite reaching the posterior angle of the segment; segments 1-7 with lateral transverse blotches, those on segment 1 meeting on the median line; large median region of abdomen whitish; segment 8 wholly colored; segment 9 small, uncolored, with very slight angular emargination; genital blotch a narrow, curving, transverse band across segment 6.

Male. Smaller, length 1.34 mm., width .38 mm.; head, length .47 mm., width .37 mm.; metathorax almost wholly fuscous; the lateral transverse blotches of abdomen longer, those on segments 6-7 almost, if not quite,

meeting on median line; last segment broadly rounded with several hairs; genitalia pincer-like.

Docophorus icterodes Nitzsch. (Plate iv, fig. 1.)

Germar's Mag. Entomol., 1818, vol. iii, p. 290.

Pediculus dentatus Scopoli, Entomol. Carniol., 1763, p. 383.

Docophorus icterodes Nitzsch, Burmeister, Handbuch d. Entomologie, 1832, vol. ii, p. 424; Gurlt. Mag. f. ges. Thierheilk., 1842, vol. viii, p. 415; Denny, Monograph. Anoplur. Brit., 1842, p. 101, pl. v, fig. 11; Grube, v. Middendorff's sibir. Reise., 1851, vol. ii, part 1, p. 468; Giebel, Insecta Epizoa, 1874, p. 115, pl. x, fig. 8; Piaget, Les Pediculines, 1880, p. 114, pl. x, fig. 1.

Specimens of this common parasite of ducks taken on the Surf Scoter, *Oidemia perspicillata*, the Ruddy Duck, *Erismatura rubida*, the Red-breasted Merganser, *Merganser serrator* (Bay of Monterey, California); and from the Mallard, *Anas boscas*, the Greenwinged Teal, *Anas carolinensis*, the Redhead, *Aythya americana*, the Lesser Scaup, *Aythya affinis*, and the Pintail, *Dafila acuta* (Lawrence, Kansas). Piaget, Giebel and Denny list fully a dozen species of ducks on which *icterodes* has been found.

Giebel has described (Insecta Epizoa) three other species of *Docophorus* (*adustus*, p. 113, *brevimaculatus*, p. 114, and *brunneiceps*, p. 114) found on ducks, and Rudow one species (*natatorium*, Zeitsch. f. ges. Naturwiss, 1870, vol. xxxv, p. 453), all of which Piaget holds to be synonyms of *icterodes*. Piaget doubts also the validity of two or three other of Giebel's species of duck-infesting *Docophori*. The wide geographical and zoological distribution of the species render variations inevitable, and its abundance on such common birds as ducks renders inevitable the observation of these variations.

The measurements of the male specimen figured are: body, length 1.4 mm., width .52 mm.; head, length .44 mm., width .4 mm. The species is easily recognizable by its conspicuous rounding, uncolored clypeus with col-

ored signature, and on each side of it the triangularly-headed anterior projection of the antennal band.

Docophorus pertusus Nitzsch. (Plate iv, figs. 2 and 3.)

Germar's Mag. Entomol., 1818, vol. iii, p. 290.

Docophorus pertusus Nitzsch, Burmeister, Handbuch d. Entomologie, 1832, vol. ii, p. 426; Giebel, Insecta Epizoa, 1874, p. 108, pl. xi, figs. 3, 12; Piaget, Les Pediculines, 1880, p. 89.

Males, females, and young from eight out of eleven specimens of American Coot, *Fulica americana* (Monterey, California), and from one out of three specimens of same bird species taken at Lawrence, Kansas. A single specimen was taken from a Ruddy Duck, *Erismatura rubida* (Monterey, California). The Ruddy Ducks and Coots are such constant associates that it is not surprising to find this Coot parasite occasionally on this species of duck. Also a single male was taken from an American Eared Grebe, *Colymbus nigricollis californicus* (Bay of Monterey, California). The characteristic forcipated appearance of the clypeus easily distinguishes the species; in some specimens the "pincers" will be found closed, so that the deep frontal emargination is quite enclosed, while in others the "pincers" will be open. My specimens do not agree with Giebel's figures and Piaget's description as to length of signature; in my specimens the acuminate posterior point extends quite to the mandibles. I figure a female, and an immature specimen. The young stage is interesting, as it shows no evidence of the pincer-like condition of the clypeus, and the clypeal signature is arrested far in front of the mandibles. The measurements of the specimens figured are: Female, body, length 2. mm., width .92 mm.; head, length .6 mm., width .6 mm. Immature, body, length 1.7 mm., width .84 mm.; head, length .52 mm., width .5 mm. Nitzsch's specimens were found on *Fulica atra*.

Docophorus lari Denny. (Plate iv, fig. 4.)

Monograph Anoplurorum Britanniae, 1842, p. 89, pl. v, fig. 9.

Pediculus lari Fabricius, Fauna Groenlandica, 1780, p. 218.

Philopterus lari Fabr., Walckenaer, Hist. Nat. Ins. Apt., 1844, vol. iii, p. 337.

Docophorus gonothorax Giebel, Zeitschr. f. ges. Naturwiss., 1871, vol. xxxvii, p. 450; Giebel, Insecta Epizoa, 1874, p. 111.

Docophorus congener Giebel, Insecta Epizoa, 1874, p. 111.

Docophorus lari Denny, Piaget, Les Pediculines, 1880, p. 111, pl. ix, fig. 7.

Many specimens of this common parasite of the gulls on *Larus argentatus smithsonianus*, *canus*, *occidentalis*, *brachyrhynchus*, *glaucescens*, *heermanni*, *vegæ*, *delewarensis*, *glaucus* and *Rissa tridactyla pollicaris* (Bay of Monterey, Cal.), and from *Larus delewarensis* (Lawrence, Kansas). In all, I have examined eighty-seven specimens of gulls of the various species mentioned, and have collected this parasite on seventy-eight of them. Piaget and others have found this parasite on *Larus canus*, *marinus*, *fuscus*, *glaucus*, *argentatus*, *ridibundus*, *atricilla*, *islandicus*, *leucophæus*, *cyanorhynchus*, *Pagophila eburnea*, *Rissa tridactyla*, *Sulla bassana*, and *Lestris parasiticus*. I have found males, females and young of this parasite on *Colymbus nigricollis californicus* and *Urinator lumme*; these can hardly be stragglers.

Piaget has named and briefly described three varieties of this species, there being apparent a considerable variation in size, in shape of the clypeus and character of the male genitalia. The careful examination of a large number of specimens from different species of gulls is necessary for an understanding of the condition of the species. I hope to have opportunity to make such a study soon.

The species is easily recognized by the strong markings, broad truncate clypeus and large acuminate signature. The female specimen figured measured as follows: body, length 2. mm., width .93 mm.; head, length .62 mm., width .63 mm.

Despite the smaller size I do not understand, from the description, how Picaglia's *D. larinus* (Atti d. Soc. Ital. d. Sci. Nat., 1885, vol. xxviii) differs specifically from *lari*.

Docophorus melanocephalus Burmeister. (Plate iv, fig. 6.)

Burmeister, Handbook d. Entomologie, 1832, vol. ii, p. 426.

Docophorus laricola Nitzsch. (in pars) Zeitschr. f. ges. Naturwiss. (ed. Giebel) 1866, vol. xxviii, p. 363.

Docophorus caspicus Nitzsch. Zeitschr. f. ges. Naturwiss. (ed. Giebel) 1866, vol. xxviii, p. 361, fig. 87.

Docophorus melanocephalus Burm. Giebel, Insecta Epizoa, 1874, p. 110, Pl. xi, fig. 8; Piaget, Les Pediculines, p. 109, pl. ix, fig. 5.

Many specimens taken from the Royal Tern, *Sterna maxima*.

This is the most abundant parasite of this Tern (Bay of Monterey, California). I found it on every one of fourteen specimens shot. The European authors record its occurrence on *Sterna caspia*, *cantiaca*, and on *Larus ridibunda* and *cirrocephalus* (localities?). Giebel describes also as a distinct species *lobaticeps* (Insecta Epizoa, p. 109), a closely related, if not identical, form taken on *Sterna hirundo* and *Sterna fassipes*. Piaget believes *lobaticeps* to be identical with *melanocephalus*.

The distinguishing characters of *melanocephalus* are its general dark color, its especially dark colored head, prominent signature with long acuminate point reaching the mandibles, slightly convex clypeal front, and the presence of a small spine and a short hair in the eye. The measurements of the female specimen figured are: Length 2.1 mm., width .9 mm.; head, length .65 mm., width .65 mm.

Nirmus præstans n. sp. (Plate v, figs. 1 and 2.)

Taken on the Royal Tern, *Sterna maxima* (Bay of Monterey, California). But two specimens, both males,

of this new *Nirmus* were taken, one from each of two birds. The new form belongs to the group *nigropicti*.

Body, length 3.25 mm., width .5; with marginal markings of black, and abdominal blotches of chestnut brown.

Head, length .56 mm., width .5 mm.; broadly conical, widest at posterior angles, with temporal margins and margins of forehead in nearly straight diagonal lines; clypeus truncate in front (even slightly concave), with three lateral short hairs; signature with broad anterior margin colored (brown); a rather broad lateral black line interrupted posteriorly by the suture, but reappearing behind the suture as a black blotch; antennal bands black, outer ends curving forward; trabeculae distinct, as long as first antennal segment; antennae with second segment longest, fifth longer than third or fourth which are equal, uncolored, except the fifth segment, which is light brown with distinct short hairs on tip; eyes with a bristle; temporal margins narrowly bordered with black and with one long hair; occipital angles rounded, posterior border doubly emarginated; occipital signature black and labium brown, visible on under side; mandibular rami strongly colored.

Prothorax quadrangular, much narrower than head; angles obtuse to rounding; lateral margins strongly and broadly colored, the colored band running inward along the posterior margin for about one-third the length of the margin and slightly expanded at inner end. Metathorax, transverse, five sided, lateral margins with a feeble concavity, posterior angles rounding with five separated, strong, pustulated hairs arranged, irregularly spaced, the three outermost close together, in a row extending inwards along the posterior margin; posterior margin obtusely angled on the abdomen; lateral margins with a strong, dark brown, linear blotch expanding at the ends; sternal

markings consisting of broad intercoxal lines, and a triangular median blotch on metathorax. Legs mostly uncolored, with femur semiannulated with dark brown at basal and distal extremities; tibiæ annulated at distal end; tarsus light brown; claws uncolored.

Abdomen, elongate ovate; posterior angles of segments with few hairs; surface glabrous, first segment without transparent lateral margin, with circular black spot in anterior angle; segments 2-6 with transparent lateral margin, narrower posteriorly; in each anterior angle a black, linear, obliquely directed blotch produced anteriorly across the suture and into the preceding segment; on segment 7 this blotch very faint or obsolete; at the posterior angle a small distinct blotch; on the eighth segment a small marginal blotch, and on the ninth a transversal, curving, brown line; on the dorsal surface a small, short, curving, median, transversal brown line on the second segment, and a similar slightly larger one on the third segment; on segments 3-6 the broad transversal blotches of the ventral surface show through, as also do the chitinized parts of the genitalia; on the ventral surface there are median transversal brown markings as follows: on the first segment a small wide triangle, on the second segment a semiellipse with convex side forward, on segments 3-6 broad transverse blotches largest on segments 4-5; genitalia showing distinctly; one or two hairs at posterior angles of segments 1-7; segment 8 with a strong, long, hair and a shorter one on lateral margin; segment 9 with strong hairs arising from dorsal and ventral surfaces of the rounded posterior margin, in all about ten.

Nirmus hebes n. sp. (Plate v, fig. 3.)

A single poorly-preserved specimen from a Royal Tern, *Sterna maxima* (Bay of Monterey, California).

Description. Body, length 1.72 mm., width .5 mm.; strongly marked, abdomen with large, lateral, transverse blotches and an uncolored longitudinal median line.

Head, length .47 mm., width .35 mm.; elongate conical, front truncate, bare (?); trabeculæ small but distinct; temporal margins subparallel, with one hair near posterior angle; antennal bands distinct, dark brown, bending inwards at the suture, and with posterior extremity expanded; temporal margins narrowly edged with dark brown; occipital bands indistinct, diverging, more strongly colored at base.

Prothorax with rounded angles, bare (?); posterior margin flatly convex, with colored lateral border. Metathorax with rounded anterior angles, diverging sides and obtuse posterior angles; angulated on abdomen; two or more hairs in posterior angles; lateral borders colored. Legs concolorous with body, with darker narrow margins. Sternal markings consisting of two pairs of intercoxal lines.

Abdomen elongate elliptical; posterior angles of posterior segments with short hairs; each of segments 2-7 with a marginal black blotch, widest anteriorly and projecting inward along the anterior margin of segment, but paling to brown; this projection stops at a median, longitudinal, uncolored line, turns posteriorly to the posterior margin of the segment and runs along the segment outwardly for a short distance; that part of the lateral portion of the segment not colored by this black and dark brown curving blotch is golden brown; segment 8 wholly colored with narrow, black, lateral margin; segment 9 uncolored, with two small, brown blotches; posterior margin feebly emarginate.

Nirmus farallonii n. sp. (Plate v, fig. 4.)

A single female specimen taken from a Farallone Cormorant *Phalacrocorax dilophus albociliatus* (Bay of Monterey, Cal.) An immature specimen taken from a Western Grebe, *Colymbus septentrionalis* (Bay of Monterey, Cal.) is also probably of this species. It may be a straggler. In general marking and outline this new species resembles *Nirmus dispar* Piaget, taken by the namer on a *Carbo sulcirostris* from a skin in the Leyden Museum. *Dispar* is a much smaller species, and lacks the characteristic median abdominal blotches of *farallonii*.

Female. Body, length 2.66 mm., width .84; ground color pale clear brown; strongly and extensively marked with dark brown.

Head, length .6 mm., width .53 mm.; conical, narrow in front and rounding; five marginal hairs, a long one on dorsal surface between the front two and two shorter ones on dorsal surface near the fourth marginal; trabeculæ small and nearly obtuse; temporal margins rounding and with one long hair and several short prickles; occipital margin slightly concave; eyes prominent, with a very short prickle; antennæ short, second segment longest, third and fourth about equal, fifth longer, concolorous with pale ground color of head; clypeal signature distinct, short pentagonal, with hinder margins and posterior angle rounded; whole head, except small parts of clypeus, pale brown; antennal bands broad, distinct, bending in at suture; small black ocular flecks, and converging occipital bands.

Prothorax shorter than broad, quadrangular with rounding angles; one long hair and one short thorny hair at posterior angle; color brown, with darker lateral bands which expand into triangular dark brown blotches in posterior angles. Metathorax broader than long, quad-

angular with lateral margins diverging slightly, and anterior angles distinctly expanding and tubercular in front of a constriction; posterior margin straight; posterior angles with one long and one short hair in point of angle, and near them five long hairs set in an elliptical clear space; brown, palest in center, lateral bands very dark in posterior two-thirds, and bending in along anterior margin. Legs colored.

Abdomen elongate elliptical, with posterior angles projecting, and two or three rather long hairs in each angle; a few long hairs on dorsal surface; segment 1 all brown, others with strong, quadrangular, lateral, brown blotches, black on outer margin, and with uncolored stigmal spots and a median quadrangular light brown blotch; posterior angles uncolored; segments 8-9 undivided, but with distinct blotches and no median blotches; segment 9 rounding, hardly if at all emarginated, and with only a few short hairs.

Nirmus orarius n. sp. (Plate v, fig. 5.)

A single specimen from a Golden Plover, *Charadrius dominicus* (Lawrence, Kansas). This form is a member of the group *obsкуро-suturati*, and resembles somewhat my species *bæphilus* from a Killdeer Plover, *Ægialitis vociferus*; the body, however, is shorter and not parallel-sided, though the form is still a slender, graceful one.

Female. Body, length 1.84 mm., width .4 mm.; pale with narrow distinct marginal markings.

Head, length .5 mm., width .28 mm.; head elongate conical, with expanded uncolored part of clypeus in front not angulated as in *bæphilus*, but rounding; three clypeal hairs and one on dorsal surface in front of the trabecula projecting over the margin; trabeculæ small, clear, but distinct; temporal margins weakly convex with two long hairs; occipital margin faintly concave; eyes flat with a

long hair; antennæ uncolored, short; clypeal signature uncolored; mandibles and labium brown, a narrow lateral brown margin along forehead interrupted in front of antennæ and at suture and along temples.

Prothorax markedly narrower than head; quadrangular, with sides converging slightly toward front; one hair in posterior angle; with brown marginal band distinct along posterior margin. Metathorax but little longer than prothorax, wider, with rapidly diverging lateral margins; posterior margin angulated; four long hairs in posterior angles, grouped in pairs, one pair being a short distance inward on posterior margin; an interrupted, lateral, brown band and a long, triangular, brown blotch projecting inwards from middle of lateral margin. Legs uncolored with weakly colored tarsi.

Abdomen elongate, with convex sides, not parallel; segments of about equal length; segment 9 short and with weak, rounding emargination on posterior margin; a few scattered weak hairs on surface, and segments 5-8 with one or two weak hairs in posterior angles; a narrow, lateral band emphatic in anterior part of each segment and margined outwardly by a narrow clear space; segments 1-6 with large, median, pale brown transverse blotch.

Nirmus gigantica n. sp. (Plate v, fig. 6.)

This well-marked *Nirmus* of the group *nigropicti* was taken from the Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). It was found on both of two birds of this species shot. I have not found it on any other bird-species.

Body, length 3.5 mm., width .87 mm.; white with a few definitely arranged black and brown spots; of about the average size and usual shape of the *Nirmi nigropicti*;

body with a few hairs on margins, general surface glabrous.

Description of male. Head, length .75 mm., width .62 mm.; conical, front produced and narrowly rounded, almost angulated; sides of forehead with five hairs, and one short one between the first two which rises on upper surface of clypeus at some distance from the margin; between second and third marginal hairs a short hair rising from surface of head so far inward that its tip does not project over the margin; temporal margins rounding, with few short hairs; occipital margin slightly and broadly concave; trabeculae wanting; eyes distinct; antennae with first and second joints longest, each as long as third and fourth, fifth longer than fourth, uncolored; clypeus uncolored; margins of forehead with a short, interrupted, dark brown line; an irregularly shaped dark brown orbital blotch; a small occipital signature; mandibles chestnut brown.

Prothorax rectangular, angles obtuse, glabrous, uncolored, with broad transparent margin. Metathorax trapezoidal, widest at posterior angles; lateral margins slightly concave, deepest before the middle; posterior margin weakly concave; a slender hair at each posterior angle, and in the angular area four long, strong hairs set closely together in a circular, uncolored spot; by each lateral margin just before the middle a conspicuous black triangle with apex directed inwards, situated in a marginal transparent space; no sternal markings. Legs uncolored except distal extremity of tibia and tarsus, which are dark brown; with a few scattered hairs.

Abdomen, third, fourth and fifth segments broadest and of about equal width, eighth much narrower than seventh, ninth very narrow and small; posterior angle of second segment with two hairs; posterior angles of segments 3-6 with three hairs, of seventh with at least four

hairs, eighth segment with two hairs at each anterior and posterior angle; ninth segment feebly angularly emarginated with one short stiff hair on each side of the emargination; lateral margins of abdomen transparent, containing entering whitish appendages of clear chitin, and on segments 2-7 a small distinct black blotch near the anterior angle of each segment; seventh segment also with a slightly curving, elongate, black fleck in the posterior angle; eighth segment marked like the seventh except that the posterior blotch is more narrowly linear; segment 9 with a narrow marginal blotch on each side.

Female generally similar to male; abdomen with one hair on posterior angle of first segment, two hairs on segments 2-4, three hairs on segments 5-7; segment 9 more acute than in male and two-pointed; segment 8 with linear blotch extending along whole length of margin; inside of lower end of this blotch and of marginal blotch of ninth segment a curving, linear, brown blotch; opening of vulva with nine stiff hairs on each margin.

This member of the *Nirmi nigropicti* differs markedly by the produced and narrowly rounded clypeus, the long metathorax with acuminate posterior margin, and the entire absence in both sexes of transverse blotches or lines on the abdomen from such forms as *punctatus*, *selliger*, and *lineolatus*, which in general appearance are somewhat similar to this new form.

Nirmus bæophilus n. sp. (Plate v, fig. 7.)

A single female taken from a Killdeer Plover, *Ægialitis vocifera* (Lawrence, Kansas). Packard's outline figure and incomplete description of *Lipeurus gracilis*, host? (Amer. Nat., 1870, vol. iv, p. 95, pl. i, fig. 6) must refer to a form resembling, in shape and markings, at least, this species. The new species belongs to the group *obsкуро-suturati*.

Description of female. Body, length 1.95 mm., width .34 mm.; very elongate and slender, parallel-sided, pale with distinct brown marginal bands on head, thorax and abdomen, and with weakly colored and ill-defined transverse abdominal markings.

Head, length .48 mm., width .23 mm.; elongate, conical, with clypeus expanded, and obtusely angled in front and at sides; the expanded part of the clypeus is uncolored; one lateral hair on expanded clypeal portion, two in front of the suture (one rising from dorsal surface and one from ventral), one at the suture, and two rising from the ventral surface and projecting beyond the lateral margin behind the suture, and one long hair rising from the internal band and projecting beyond the lateral margin of the forehead; trabeculae small but distinct, acute; temporal margins subparallel, with one long hair and one shorter hair; occipital margin concave; eyes inconspicuous; antennae with second segment longest, fifth next, third next, fourth next, segment 1 short and thick, uncolored, except a faint brownish tinge on segment 5; clypeal signature triangular with apex toward the mandibles; entire lateral margin of head narrowly dark brown, interrupted at clypeal suture and emphasized at beginning of antennal band; uncolored occipital bands converging toward the mandibles, and uncolored internal bands bending outward at suture to meet antennal bands and in front of mandibles to enclose oral fossa.

Prothorax truncated, conical, sides converging in front, with well defined brown marginal bands around the entire segments, and a single hair at posterior angle. Metathorax but little longer than prothorax, wider, also truncated conical with lateral brown bands interrupted at middle, and three long hairs in posterior angle, and one pustulated hair on each latero-posterior margin; a me-

dian, long, spear-head shaped sternal blotch of pale brown showing through. Legs with colored tarsi and strong claws.

Abdomen very long, slender, parallel sided, with few scattered long hairs on surface and in posterior angles of segments; segments 8-9 tapering posteriorly; segment 9 slightly but angularly emarginated, without terminal hairs on points; all segments with distinct narrow lateral brown bands, slightly expanding at front of each segment and projecting across the sutures; segment I with truncated, conical, paler, median blotch; other segments with indistinct, large, quadrangular, median blotches.

Nirmus punctatus Nitzsch. (Plate vi, figs 1 and 2.)

Germer's Mag. Entomol., 1818, vol. iii, p. 291.

Philopterus grammicus Gervais, Hist. Nat. Apteres, 1847, vol. iii, p. 350.

Nirmus punctatus Nitzsch. Nitzsch. (ed. Giebel) Zeitschr. f. ges Naturwiss., 1866, vol. xxviii, p. 377; Giebel, Insecta Epizoa, 1874, p. 176, pl. iv, figs. 1, 2; Piaget, Les Pediculines, 1880, p. 200, pl. xvi, fig. 4.

A female and two immature specimens taken from a Western Herring Gull, *Larus occidentalis* (Bay of Monterey, California). This species was found by Nitzsch on *Larus ridibundus*, and by Piaget on a *Larus dominicanus* from Chili, a *Larus crassirostris* from China, and a *Larus ichthyaëtus* from the Volgas; a well distributed form, surely. Piaget's figure omits the short hairs at the anterior angles of the clypeus present apparently in all *nigropicti*, and his description consistently with the drawing refers to but three hairs on each side of the clypeus, where there are really four. The specimen is much larger (length 2.4 mm.) than Piaget's seem to have been, the average length of his female specimens being 1.9 mm.

Description of young. Length, 1.5 mm., differing from adult specially in incompleteness of markings and relative

shortness of body. Head, length 5 mm., width .41 mm.; more rounding than truncate in front and without colored markings, except dark brown labium and pale brown mandibles; ratio of breadth to length greater than in adult. Thorax with a lateral small black blotch near anterior angle of metathorax. Abdomen, length .81 mm., width .41 mm.; without median markings, a small black blotch at anterior angle of segments 1-7, blotches growing smaller in each succeeding segment.

Nirmus felix Giebel. (Plate vi, figs. 3 and 4.)

Insecta Epizoa, 1874, p. 175.

Two specimens, both males, taken from two specimens of Heerman's Gull, *Larus heermani* (Bay of Monterey, California), may be attributed to this species of Giebel established on a single female taken from the same species of gull. Piaget (Les Pediculines, p. 201) assumes to believe Giebel's specimen a variety of *punctatus*. "Cette espèce ne me paraît non plus qu'une variété du *punctatus* où l'occiput n'est pas bordé de noir et les taches de l'abdomen sont plus allongées transversalement." But the differences between the males taken by me and the male *punctatus* are much more considerable than this. The black bordering of the head and the strong tripartite blotches of the abdomen remove it distinctly from any immediate similarity with *punctatus*; in fact, the species more nearly resembles *lineolatus* than *punctatus* (compare figures 1, 3, 4, 7 and 8, plate vi). Its most striking resemblance, however, is to *præstans*, the transparent clypeus, different abdominal markings and markedly different male genitalia distinguishing it from *præstans*.

Description of male. Body, length 3.66 mm., width .62 mm.; white, with dark brown or black marginal markings, and chestnut brown, median abdominal markings.

Head, length .53 mm., width .50 mm.; conical, clypeus truncate, even slightly concave in front, a short hair at each anterior angle and five other short hairs in the lateral margin between it and the small but distinct trabecula; temporal margin slightly rounding, with two longish hairs, and behind the hinder one two very short, stiff, prickle-like hairs; posterior margin straight; antennæ uncolored, second segment longest, third, fourth and fifth segments about equal; anterior part of clypeus transparent, and a transparent space on each side just inside of trabeculæ; margin of forehead with a twice-interrupted, uneven, black line, the middle third of it not contiguous to the margin and thickly crescentic; a black border along the temporal margins, bending inwards at anterior end; labium black; mandibles chestnut brown.

Prothorax quadrangular, bordered laterally with black, which runs inward along the posterior margin one-third the length of the margin; a single hair at posterior angles. Metathorax pentagonal, bordered on the anterior lateral margins with dark brown, inside of which the short, curving, black, intercoxal lines of the sternum show through; posterior lateral angles with five strong pustulated hairs almost exactly as in *præstans*; posterior margin angulated on abdomen; sternal markings consist of an obtusely-pointed, nipple-like fleck, projecting inwards from lateral margin of metathorax. Legs, femur with brown fleck at basal end and tibia with brown blotch at distal end, tarsus brown, otherwise white; tibia with three short, stiff hairs on inner side and one on outer side; femur with two or three short hairs arising in basal blotch.

Abdomen with segment 4 widest; nearly parallel-sided for most of its length; segment 1 with small black blotch at anterior angles, segments 2-7 with triangular (segments 2-3), or curving, angulated (segments 4-7) blotches

in anterior angles, with transparent spots at posterior angles and margins narrowly transparent; segment 8 with irregular black marginal blotch; segment 9 with two short chestnut lines parallel with posterior rounding margin; on dorsal surface of segments 2-6 a median transverse chestnut line shortest on second and on sixth segments, and with anterior border of each mark emarginated; ventral surface of segment 5 with broad transverse chestnut blotch almost divided in the middle; segments 4 and 6 with such blotches completely and widely divided, making two lateral blotches on each segment; segment 3 with faint indications of such lateral blotches; genitalia confined to segments 7-8, side pieces angulated with points projecting inwards and slightly crossing each other at tips; posterior angles of abdominal segments with few long hairs; segment 8 with hairs rising from middle of margin; segment 9 with about twelve hairs along posterior margin which is broadly rounded.

Nirmus signatus Piaget. (Plate vi, fig. 5.)

Les Pediculines, 1880, p. 186, pl. xv, fig. 8.

Nirmus signatus Piaget, König, Ein Beitrag zur Mallophagenfauna, 1884, p. 10.

Three males and three females taken from an American Avocet, *Recurvirostra americana* (Lawrence, Kansas). Piaget found this species common on *Recurvirostra avocetta* (Zool. Garden of Rotterdam), and König found it abundant on the same bird species taken near Kiel.

As Piaget figures only the female, and the differences between the sexes in shape and markings of abdomen and character of last segments is considerable, I figure the male. The difference in size between the sexes is considerable, as shown by the following measurements of my specimens: Male, body, length 1.9 mm., width .5 mm.; head, length 5 mm., width .36 mm. Female, body,

length 2.5 mm., width .62 mm.; head, length .56 mm., width .4 mm. The characteristic markings of the species, especially the large and sharply-defined signature, make it easily recognized.

Nirmus pileus Nitzsch. (Plate vi, fig. 6.)

Germer's Mag. Entomol., 1818, vol. iii, p. 291.

Nirmus pileus Nitzsch, Zeitschr. f. ges. Naturwiss., 1866, vol. xxviii, p. 373; Giebel, Insecta Epizoa, 1874, p. 162; Piaget, Les Pediculines, 1880, p. 182, pl. xv, fig. 6.

A single specimen, female, taken from an American Avocet, *Recurvirostra americana* (Lawrence, Kansas). Nitzsch's and Piaget's specimens were taken on *Recurvirostra avocetta*. I figure the female, although Piaget's figure is excellent, for the convenience of American students. The measurements of the specimen are: Body, length 2.8 mm., width .78 mm.; head, length .62 mm., width .60 mm. These measurements vary a little from Piaget's, my specimen being shorter and wider, and the head a fifth greater in length and width.

Nirmus lineolatus Nitzsch. (Plate vi, figs. 7, 8 and 9.)

Zeitsch. f. ges. Naturwiss., 1866, vol. xxviii, p. 376 (ed. Giebel).

Nirmus ornatus Grube, v. Middendorff's sibir. Reise zool., vol. i, p. 477, pl. i, fig. 4.

Nirmus lineolatus Nitzsch, Burmeister, Handb. Entomol., 1838, vol. ii, p. 428; Giebel, Insecta Epizoa, 1874, p. 177; Piaget, Les Pediculines, 1880, p. 199.

I have taken this common *Nirmus* of the gulls from *Larus argentatus smithsonianus*, *brachyrhynchus*, *glaucescens*, *canus*, *vegæ*, *occidentalis*, *heermanni*, *californicus*, *delewarensis* (Bay of Monterey, California). Nitzsch found it on *Larus canus*, *argentatus*, *glaucus*, *tridactylus*, and Piaget on *argentatus* and *glaucus*. It is readily distinguishable by its characteristic head markings and by the ventral abdominal blotches and the genitalia of the male. The young, which I have found in many stages of growth,

differ from the adult, especially in the shape of the head and the markings of the body.

Description of very young. Body white, with few brown markings. Head short, broadly conical; front rounded; temporal angles with a single long hair; front with two very short hairs on each side (invisible except under high magnification); antennæ rather short and thick, uncolored; mandibles pale brown; a small black ocular fleck; head otherwise uncolored. Thorax shaped as in adult, with but four long metathoracic hairs instead of six; prothorax unmarked; a small fleck at anterior angle of metathorax. Abdomen with sides subparallel; no medial markings; a small lateral marginal blotch on segments 1-7; segments 1-4 without hairs at posterior angles.

Lipeurus densus n. sp. (Plate vii, figs. 1 and 2.)

A single female specimen taken from a Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). The form is a well-marked member of the group *circumfasciata*. As indicated by the clypeus, the simple lateral bands of the abdomen, and the concave posterior margin of the metathorax, it somewhat resembles *heterogrammicus* taken by Nitzsch and Piaget on *Perdix cinerea*.

Description of female. Body, length 4.3 mm., width .81 mm.; white, strongly marked with dark brown and black; sides subparallel.

Head, length .94 mm., width .75 mm., sides nearly parallel; clypeus obtusely angulated in front; six hairs on each side of forehead, the anterior one longest; trabeculæ wanting; antennæ uncolored, second segment longest, as long as fourth and fifth together, first and third about equal in length, with a very few scattered short hairs; eye prominent, hemispherical; temporal margin with two minute hair prickles, no other hairs; occipital margin concave; a strong, dark brown band completely bordering fore-

head, and continuing, interrupted at antennary fossæ, along temporal margins almost to occipital angles.

Prothorax quadrangular, convex on metathorax; two separated hairs at occipital angles; a lateral marginal brown blotch bounded outwardly along its posterior half by a transparent edge. Metathorax with lateral margins concave, deepest before the middle; anterior angles obliquely truncate; posterior margin straight or feebly concave; three long, strong, hairs in the posterior angles, arising from an elliptical uncolored space; a large brown blotch in anterior angles, and a smaller one in posterior angles, also a narrow marginal band running full length of segment. Sternal markings consisting of a faint bordering of anterior coxal cavities, an intercoxal line between pro- and mesacoxæ, an obscure median semicircular blotch with convex margin posteriorly, and a rather broad lateral marginal band on metathorax. Fore legs short, coxæ narrowly separated and globular, femora wide, tarsi alone colored; middle and hind legs long, coxæ produced widely and separated; femora long and slender; femora and tibiæ with dorsal, elongate, dark brown markings; tarsi and claws pale brown; tibiæ with two long hairs and three short ones on outer margin.

Abdomen with sides of segments 1-7 parallel; sides of segments 8-10 tapering posteriorly, tenth segment bicuspidate; posterior angles of segments 1-4 without hairs, angles of segments 5-6 with one hair, of segment 7 with three hairs, segment 8 with one hair rising before the angle, segment 9 with two hairs, segment 10 with each posterior point bearing four hairs, two arising on margin and one each from dorsal and ventral surfaces; a strong broad, dark brown, marginal band, this band projecting in on segment 9 almost to median line; segment 10 wholly colored.

Lipeurus varius n. sp. (Plate vii, figs. 3 and 4.)

A common parasite of the Pacific Fulmars, *Fulmarus glacialis* vars. *glupischa* and *rodgersii*, being found by me on twenty-six out of thirty specimens of these Fulmars shot on the Bay of Monterey, California. This white and blotched species belongs to the *Lipeuri circumfasciati*, and shows some similarity of appearance to *tricolor* Piaget (Les Pediculines, p. 363, pl. xxx, fig. 4), taken from an Albatross. Although this parasite was found on nearly all the Fulmars shot, on none was it present in large numbers (as was its companion *Lipeurus celer*), and among all the specimens taken by me, perhaps one hundred in total number, there is not a male.

Description of female. Body, length 2.9 mm., width .62 mm.; white, with distinct dark brown markings, marginal on head and thorax, and as lateral blotches not reaching the margins on abdomen.

Head, length .6 mm., width .4 mm.; sides subparallel, front parabolic, with five marginal hairs on forehead, one of which is separated from the others and close to angle of antennary fossa, and a short hair on dorsal surface projecting beyond the margin between first two marginal hairs; trabeculae wanting; temporal margins with a single short hair; eyes distinct, with a fine prickle on margin just behind them; occipital margin straight; head uncolored and pale smoky brown, with dark brown circumferential antennal bands and ocular blotches which extend backwards, paling, over temporal region; antennae uncolored, first two segments about equal, third and fourth equal and shorter, and fifth slightly longer than third or fourth.

Prothorax nearly square, angles rounding, posterior ones slightly swollen; whitish, except even dark brown lateral border. Metathorax elongate, slightly widening

posteriorly, anterior angles swollen, posterior margin straight, with four long hairs, not pustulated, in posterior angles; lateral margins unevenly bordered with black and dark brown, widest anteriorly; sternal blotch pale brown, anterior part elliptical, with a backward-projecting, long, slender, tapering process. Legs uncolored except for pale brown tarsi and claws.

Abdomen slightly widening to segment 6, and then more rapidly narrowing; white, with two lateral brown quadrangular blotches, fading inwardly, and each, except on segments 1 and 7-9, with uncolored stigmatal spot; these distinct and characteristic lateral blotches do not touch the lateral margin, the white marginal border varying from very narrow to one-half the width of the blotches, as in the specimen figured; ninth segment angularly emarginated with two hairs on each point.

I figure an immature specimen which is about one-half the size of an adult; it lacks entirely the abdominal markings, showing small portions, but intensely colored, of the thoracic and head markings. The presence of but one of the long metathoracic hairs is interesting, and the usual large head, characteristic of the immature stages, is noticeable.

Lipeuru celer n. sp. (Plate vii, figs. 5 and 6).

This large dark form was found in great numbers on all specimens except one of thirty Pacific Fulmars, *Fulmarus glacialis* vars. *glupischa* and *rodgersii* (Bay of Monterey, California), examined by me. It belongs to Taschenberg's group, *clypeati sutura indistincta*, and its most obvious resemblances are to *grandis* taken by Piaget on *Procellaria pclagica* in the Zoological Garden of Rotterdam. It is distinguished from *grandis* by the different form of the head, by lacking the occipital signature, by the presence of occipital bands, by the markedly different

abdominal markings, by the different character of the last segment of the male, and by other less obvious characters. Its dark color and large size make it a conspicuous object on the birds.

Description of female. Length 3.37 mm., width .7 mm.; body everywhere brown, the accentuated markings black, sides of head, thorax and abdomen subparallel.

Head, length 7. mm., width .5 mm.; sides nearly parallel; clypeus narrowly rounded in front with six lateral short hairs of which four are located along the margin at nearly equal distances apart, one arising from the dorsal surface near the anterior marginal hair, and one near the antennæ; trabeculæ wanting; temporal margins weakly convex with one long hair; antennæ with segments 1-2 about equal in length, segment 3 but little shorter, segments 4-5 shorter and feebly colored; whole head chestnut brown; clypeal signature wide anteriorly, short, and acuminate posteriorly; the pronounced antennal bands projecting inward at their basal extremities; the irregular orbital blotches, the narrow temporal marginal bands, and the distinct occipital bands much expanded at occipital margin, black or strongly dark brown.

Prothorax short, quadrangular, slightly wider posteriorly; chestnut brown, paler in the middle; lateral borders black. Metathorax widest at posterior angles; brown; lateral margins broadly and irregularly bordered with black; four long hairs arising from an uncolored spot. Sternum almost completely brown, showing a broad long median blotch abruptly pointed behind, set off by narrow uncolored lines from the broad lateral bands. Legs with coxæ, femora and tibiæ dark brown; femora paler on inner side and at distal extremity; trochanters uncolored; tarsi pale brown.

Abdomen with sides nearly parallel; segment 8 nar-

rower and segment 9 very narrow and short; segment 1 shorter than the nearly equal segments 2-7; all segments brown; segments 1-7 with a rather broad, black, lateral, marginal blotch, emarginated on inner face; these blotches touching at the sutures produce a continuous lateral band emarginated on each segment; segment 8 not distinctly blotched, but with narrow lateral black margin; segment 9 slightly emarginated, and with a brown blotch on each side; segment 1 especially, and segment 2 with an ill-defined median blotch of dark brown; the sutures between segments 2-7 showing except at lateral ends as uncolored lines; below, the lateral bands are narrower and not emarginated (or faintly on each segment); segment 1 with distinct median blotch, and segment 2 with a larger indistinct blotch; one or two hairs at posterior angles of segments; on segments 7-9 more hairs.

Male. Body, length 3.44 mm., width .59 mm.; head, length .72 mm., width 5. mm. Antennæ, first joint as long as all others combined, second next longest, third short with a dorsal angular projection at distal extremity, fifth slightly longer than fourth; first, fourth and fifth more colored than others. Abdominal segments with complete transverse dark brown bands, black at lateral margins, and with paler stigmatal spots; ninth segment very small and not emarginated.

Rudow (Zeitschr. f. ges. Naturwiss., 1870, vol. xxxv, pp. 121-137), describes several *Lipeuri* taken on *Procellaria*, and one, *nigricans*, is a form as dark as *celer*, but all of these species are small, *nigricans* being but 1.5 mm. long.

Lipeurus longipilus n. sp. (Plate vii, fig. 7.)

A few males and females taken from two specimens (out of ten shot) of the American Coot, *Fulica americana*

(Monterey, California). The species was not present on any one of five Coots taken at Lawrence, Kansas. A well-marked member of the group *clypeati sutura distincta*.

Description of the male. Body, length 2.4 mm., width .4 mm.; fuliginous with paler femora, antennæ, prothorax and posterior half of abdomen, and black marginal bands on head, thorax and abdomen.

Head, length .53 mm., width .35 mm.; elongate, conical, with narrowly parabolic front, four marginal hairs in front of suture and three behind it; temporal margins with one hair, occipital margin straight or feebly concave; no trabeculæ; eyes inconspicuous; antennæ, first segment short, second segment large, broadest at base, almost as long as third, fourth and fifth together, third deeply notched and with an acute claw-like extremity, fourth and fifth short, cylindrical and more strongly colored than other segments; signature shield-shaped, extending to front margin of head, pale-colored anteriorly, with indistinct transverse striæ parallel with anterior margin, dark brown behind, a distinct suture extending from posterior angle along the median line not quite to the anterior margin of signature; this suture also extending posteriorly almost to mandibles; antennal bands broad, dark and straight; temporal margins bordered with black, paling inwardly; an acorn-shaped occipital signature, apex forward.

Prothorax almost square, bare, with uniform lateral marginal black band, which bends inwardly at the posterior angle. Metathorax quadrangular, longer than broad; anterior angles diagonally truncate; a slight constriction behind the anterior angles; posterior margin straight, with three very long hairs and one shorter hair in each posterior angle; segment dark brown, with uneven

lateral border of black, widest at constriction. Legs with dark colored coxæ and tibiæ, paler femora with darker markings.

Abdomen elongate, first segment much narrower than thorax at articulation, segments gradually widening to the fifth and narrowing from there to the ninth; segments 5-7 shorter than others; segments 1-2 with one hair at posterior angle, segment 3 with two hairs, and remaining segments with much longer hairs; distinct marginal black bands, with clear segmental spots; transversal dark brown bands, narrower on segments 5-7; ninth segment wholly colored and angularly emarginated, the points each with two short hairs.

Female. Body, length 2.65 mm., width .5 mm.; head, length, .55 mm., width .35 mm.; slightly larger than male; antennæ, second and fifth segments about equal, longest, third and fourth about equal; abdomen with segments gradually shortening from first backward through the seventh, eighth slightly longer, ninth deeply angularly emarginate, the two acute points without hairs; from the dorsal face of the eighth segment two very long hairs arise just inside of the black lateral band; all segments wholly colored except posterior half of the eighth; the transverse sutures uncolored, and indications of an uncolored median longitudinal line on segments 3-6; lateral marginal bands black, with clear stigmatal spots on inner margin.

Lipeurus picturatus n. sp. (Plate viii, figs. 1 and 2.)

Four specimens, all female, taken on two specimens of American Coot, *Fulica americana* (Monterey, California), out of ten shot. No specimens found on four Coots killed at Lawrence, Kansas. A finely-marked form, with indistinct suture.

Description of female. Body, length 2.1 mm., width .35 mm.; slender, parallel-sided, strongly marked with brown and black in regular blotches and bands.

Head, length .5 mm., width .32 mm.; elongate conical with narrowly rounding or parabolic front; a weakly projecting very obtuse angle at suture; six marginal hairs, of which four are grouped about this angle; trabeculæ small but distinct; temporal margins with one hair; occipital margin concave; antennæ uncolored; segments 1-4, beginning with 1, gradually shorter, fifth segment as long as second; signature broad, paler in front and with indistinct transverse striæ parallel with anterior margin, posterior margin concave, and with a broad, uncolored median line running from this border nearly to anterior margin; the signature is thus almost divided longitudinally; antennal bands black, extending anteriorly and fading into the paler color of the signature; temporal margins unevenly bordered with blackish, and bearing one hair; an acorn-shaped occipital signature indistinctly showing through from under surface.

Prothorax almost square, with posterior margin slightly angulated on the metathorax; clear smoky brown in middle, with black lateral borders expanded in anterior angles. Metathorax longer than broad, sides diverging slightly, anterior angles diagonally truncated with a distinct lateral angle; posterior margin straight; four hairs in posterior angle, three of which are in a clear space. Legs pale with smoky brown to black markings.

Abdomen slender, subparallel-sided, with single hairs at posterior angles, longer on posterior segments; segments 1-2 longest; others successively shorter; segment 9 deeply angularly emarginated, the points acute; first and ninth segments wholly colored; others, except segment 8 which has a curving, transverse band extending

entirely across, with narrow marginal black bands, and two quadrangular smoky brown blotches separated from each other and from lateral band by uncolored spaces.

In an immature specimen (plate viii, fig. 2) of about same size as adults, the markings are less intensely colored, the occipital signature and precoxal lines of ventral surface showing through, and the segmental parts of the marginal abdominal bands distinct, so that each segment appears to have four blotches, the outer ones darker.

***Lipeurus diversus* n. sp.** (Plate viii, figs. 3 and 4.)

Several specimens taken from the Black-vented Shearwater, *Puffinus opisthomelas* (Bay of Monterey, California). The species is very like, in outline and markings, Piaget's species *angusticeps* (Les Pediculines, p. 306, pl. xxv, fig. 4) from a *Thalassidroma leachi* (Zool. Garden of Rotterdam), but shows such marked difference in size and certain details that it must be looked on as a distinct species.

The measurements of the specimens are (following in parentheses are the corresponding dimensions of *angusticeps* as given by Piaget): Male, body, length 3.4 mm. (2.8 mm.), width .37 mm. (.30 mm.); head, length .7 mm. (.6 mm.), width .37 mm. (.28 mm.). Female, body, length 4.1 mm. (3.65 mm.), width .5 mm. (.46 mm.); head, length .72 mm. (.65 mm.), width .43 mm. (.37 mm.). The description of the species in general is that given for *angusticeps* differing as follows: Male, the posterior border of the signature angularly concave, not straight; the temporal margins with two short hairs instead of one; the antennal colored bands bending inwards at the clypeal suture and continuous with the internal bands which bound the oral fossa; the metathorax with five long hairs on posterior angles instead of two; the

legs concolorous with the pale body color, not strongly colored; the last two segments of the abdomen not, as in *angusticeps*, with straight tapering sides bearing six short hairs and the last segment emarginated, but with convex margins with two or three rather long hairs, and the last segment very finely if at all emarginated. Female, the last segment of the abdomen not "*profondément entaillé*," but slightly and narrowly emarginated; also no median uncolored line on the first two segments.

Lipeurus limitatus n. sp. (Plate viii, figs. 5 and 6).

Three females taken from a Dark-bodied Shearwater, *Puffinus griseus* (Bay of Monterey, California). This species belongs to the group *clypeati sutura indistincta*, and is the first *Lipeurus* to be found on *Puffinus*.

Description of female. Body, length 2.75 mm., width .41 mm.; slender, parallel-sided, pale with light yellowish brown well defined markings.

Head, length .6 mm., width 4. mm.; elongate, conical, front rounded, with four short marginal hairs, one on dorsal surface between first and second marginal hairs, and one very short hair at antennal angle; trabeculae wanting; temporal margins with one hair; occipital margin nearly straight; eyes inconspicuous; antennae with second segment longest, first nearly as long, fifth slightly longer than either the third or fourth, which are equal, concolorous with the head or paler; whole head pale, yellowish brown, with darker marginal bands of forehead connected at front by paler striated clypeal band; a narrow, frontal margin of the clypeus transparent; the rest of the clypeus pale brown, hinder margin emarginated; a brown ocular blotch, and the temporal margins near the eyes feebly browner than head color.

Prothorax short, hexagonal, with latero-anterior mar-

gins short and hardly distinct from lateral margins; lateral margins narrowly darker colored than rest of segment; no hairs. Metathorax almost three times as long as prothorax; sides subparallel; hind margin feebly convex or slightly angulated on abdomen; with four long hairs and one short one in posterior angles, the short hair being next to the outermost hair; the lateral margins very narrowly darker edged along their hinder half. Legs concolorous with body, dorsally narrowly darker edged.

Abdomen slender elongate, subparallel-sided, growing slightly wider to segment 7, segments 8-10 tapering; segments 1-7 subequal in length, segment 8 half as long as segment 7, segment 9 shorter than segment 8; segment 10 obtusely two-pointed; very sparsely haired, segments 2-6 with one short hair on margin just in front of posterior angle; a square pale brown blotch on each side of segments 1-7, darker-edged outwardly, and separated by a distinct median uncolored line; blotches of segment 8 meeting, and the markings of segment 9 continuous.

Lipeurus constrictus n. sp. (Plate viii, figs. 7 and 8.)

Found on three out of six specimens of the Surf Scoter, *Oidemia perspicillata*, and on one out of six specimens of the White-winged Scoter, *Oidemia deglandi* (Bay of Monterey, California); also found on a specimen of *perspicillata* taken at Lawrence, Kansas (Kansas River, during migration). The new form belongs to the group *bisetosi*, and is distinguished from *squalidus*, the member of the group which the new form most resembles by the smaller size, by the narrow basal abdominal segments, and by the concave hinder margin of the clypeal signature. Many specimens, males, females and young were taken.

Description of the male. Body, length, 2.31 mm., width 5 mm.; general habitus of *squalidus*, but distinctly

smaller and with waist-like narrow basal abdominal segments.

Head, length .53 mm., width .41 mm.; temporal margins with five very short stiff hairs or prickles and one longer hair; antennal bands most strongly marked at anterior end, ocular blotch dark brown, and temporal margin broadly banded with brown paling internally. Lateral bands of prothorax darkest at posterior angles. Metathorax with large, lateral, marginal, dark brown blotch in front of the middle, and margin behind the blotch dark brown; hairs seven, as in *squalidus*. Legs concolorous with body, tarsi and claws darker. First two abdominal segments much narrower than succeeding ones, segments 4-5 the widest; segments 3-6 with two hairs, a long one and a short one, at posterior angles; segment 9 feebly emarginated, thus obtusely two-pointed; segment 1 short, segments 2-3 longest and equal, segments 4-5 next longest and equal, segment 6 very short especially in middle, segments 7-8 equal; lateral marginal bands distinct, dark brown; within pale yellowish brown quadrangular blotches separated by uncolored median line on segments 2-4.

The female is larger; body, length 3.12 mm., width .66 mm.; head, length, .63 mm., width .5 mm.; first abdominal segments shorter, segments 2-7 about equal, segment 9 very slightly emarginated.

The young of this species, as probably of all *bisetosi*, show characteristic transparent, narrow, lateral, abdominal margins, and on segments 1-7 along the lateral third of the hinder margin of each segment a linear transparent space; no brown markings.

Lipeurus punctulatus of Rudow (Zeitsch. f. ges. Naturwiss., v. xxxvi, p. 137), from *Oidemia fusca* is probably an immature specimen of this species.

Lipeurus ferox Giebel. (Plate ix, figs. 1 and 2.)

Zeitsch. f. ges. Naturwiss., 1867, xxix, p. 195.

Pediculus diomedæ. Fabr. Ent. Syst., 1794, iv, p. 421.

Lipeurus diomedæ Dufour. Ann. Soc. Ent. France, 1834, iv, p. 669, figs. 1 and 2; Giglioli, Quart. Jour. Mic. Sci., 1864, iv, N. S., p. 19, plate i, b, figs. 1, 2.

Lipeurus pederiformis Dufour. Ann. Soc. Ent. France, 1834, iv, p. 676, pl. 26, fig. 4.

Lipeurus ferox Giebel. Insecta Epizoa, 1874, p. 235. Piaget, E. Les Pediculines, 1880, p. 333. Taschenberg, O., Die Mallophagen, 1882, p. 145, pl. v, figs. 1, 1a.

To this large and striking species may be attributed three specimens, one male and two females, taken from the Short-tailed Albatros, *Diomedea albatrus*. The male was taken from one bird, the two females from another; these two birds, both immature, were the only specimens of this bird species taken on the Bay of Monterey. The various descriptions of *ferox* by Giglioli, Giebel, and Taschenberg differ somewhat; Giebel had only a male before him; Taschenberg had in addition an immature female, and while Giglioli had both sexes his descriptions are incomplete.

Description of female. Body, length 9. mm., tapering from sixth abdominal segment abruptly to tip of abdomen, and gradually toward the head; strongly and distinctly marked with dark brown on both sides of the body for its whole length; a median uncolored line widest on head and on sixth abdominal segment; body nearly glabrous.

Head, length 2.1 mm., width 1.4 mm.; widest behind the eyes; margins of head in front of antennæ nearly straight and oblique; temporal margin feebly rounding; occipital margin weakly concave; clypeal suture distinct; clypeus convex in front, without hairs or bristles: at suture a slight rounded emargination, with one long hair, and behind it five short hairs, farther back one short hair, and in front of insertion of antennæ two short hairs; sig-

nature large, broadly triangular with rounded angles, front margin parallel with margin of clypeus; antennæ with first segment uncolored, the remaining four brown, segment 2 longest, segments 1 and 3 about equal, segment 5 shorter than segment 4, each segment with a few short hairs; angles of antennary fossæ not projecting; eyes prominent; temporal margin with a few very short bristles; head broadly margined, widest posteriorly, with dark brown; a dark brown band across the head immediately behind the clypeal signature.

Length of thorax 2.5 mm., width 1.9 mm.; prothorax forming a parallelogram a little wider than long, the angles weakly rounded; lateral borders dark brown, extending inward along the front and hind margins toward the middle, but not reaching it, leaving the middle third of the segment uncolored. Metathorax expanding posteriorly; lateral margins with some small, uneven, rounded projections about the middle; posterior margin slightly concave, angles acute; near each angle near the posterior margin a single pustulated hair, and a little further in seven long pustulated hairs grouped in a small, elliptical, uncolored space; the whole metathorax strongly brown except narrowly along the posterior margin and behind and at the sides of a central longitudinal brown quadrangle (the sternal blotch showing through). Legs strong, with elongate coxæ, very short thick tarsi, with short thick claws; everywhere dark brown, except at the basal and distal extremities of coxæ and femora and the tarsi; a few scattered hairs.

Abdomen, length 4.5 mm., width 2. mm.; widest at sixth segment, tapering sharply to posterior extremity; posterior lateral angles of one segment projecting over anterior lateral angles of succeeding segment; segment 1 shortest, segment 7 longest; color mostly dark brown,

consisting of very dark lateral border and large transverse lateral blotches, those of segment 6 meeting at middle line, others not meeting; an uncolored, median, longitudinal line interrupted on segment 6; on ventral side transverse blotches continuous across all the segments; anterior and posterior margins of each segment narrowly uncolored; an ill-defined stigmal uncolored spot on segments 2-7; segment 8 conical, much narrower than segment 7, and segment 9 very short and narrow, two-pointed, each point bearing two strong hairs; sparsely haired; posterior lateral angles of segment 1 with one hair, of segments 2-4 with two hairs, of segments 5-6 with three hairs, of segment 7 with four hairs; segment 8 with two strong hairs near anterior lateral angle, two shorter hairs on side and three separated, strong, pustulated hairs on each half of posterior margin.

The male specimen of *ferox* taken by me differs rather markedly in some respects from Taschenberg's careful description of the specimen in his hands. Indeed, it has been a question with me whether my specimens could fairly be attributed to this species.

***Lipeurus forficulatus* Nitzsch.** (Plate ix, figs. 3, 4, 5 and 6.)

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1866, vol. xxviii, p. 386.

Lipeurus forficulatus Nitzsch, Giebel, Insecta Epizoa, 1874, p. 238;

Taschenberg, Die Mallophagen, 1882, p. 157, pl. iv, figs. 6, 6a, 6b.

Taken from four of five specimens killed of the California Brown Pelican, *Pelecanus californicus* (Bay of Monterey, California), and on two White Pelicans, *Pelecanus erythrorhynchos* (Lawrence, Kansas), the parasites numerous on the birds. Nitzsch's specimens were taken from *Pelecanus onocrotalus* (locality?). My specimens show distinctly the short forked projection on the first segment of the antennæ of the male, the character noted

by Taschenberg which distinguishes this species from the otherwise similar form *bifasciatus* Piaget, found on *Pelecanus crispus* (Zool. Garden of Rotterdam).

I figure both sexes, although Taschenberg's figure of the male is good. I figure also two stages of the young. The measurements of the specimens figured are as follows: Male, body, length 2.6 mm., width .62 mm.; head, length .52 mm., width .5 mm. Female, body, length 2.7 mm., width .9 mm.; head, length .56 mm., width .56 mm. Young female, body, length 2.28 mm., width .72 mm.; head, length .5 mm., width .48 mm. Very young, body, length 1. mm., width .44 mm.; head, length .375 mm., width .44 mm.

***Lipeurus temporalis* Nitzsch.** (Plate x, fig. 1.)

Germar's Mag. Entomol., 1818, vol. iii, p. 292.

Ricinus mergi serrati De Geer, Mem. pour servir a l'hist. des Insectes, 1778, vol. vii, p. 78, pl. iv, fig. 13.

Pediculus mergi Fabricius, Species Insectorum, 1781, vol. ii, p. 480.

Lipeurus temporalis Nitzsch. Denny, Monograph. Anoplur. Brit., 1842, p. 175, pl. xiv, fig. 7; Giebel, Insecta Epizoa, 1874, p. 239; Piaget, Les Pediculines, 1880, p. 350, pl. xxxi, fig. 1.

Two females and a male taken from a Red-breasted Merganser, *Merganser serrator* (Bay of Monterey, California). The measurements of the female are: body, length 3.21 mm., width .9 mm.; head, length .7 mm., width .44 mm.

Male. Body, length 2.56 mm., width .5 mm.; head, length .66 mm., width .5 mm. Both Denny's and Piaget's figures are of the female. I figure the male.

***Lipeurus testaceous* Tschb.** (Plate xi, figs. 2 and 4.)

Taschenberg, Die Mallophagen, 1882, p. 135, pl. v, fig. 3.

With some doubt I refer to this species five individuals taken from a Black-vented Shearwater, *Puffinus opisthomelas* (Bay of Monterey, California). Taschenberg's

specimens, females only, were taken from *Procclaria capensis* (locality ?).

My adult specimens (three females) differ from Taschenberg's description in these details: the eye has a small hair not mentioned by Taschenberg; the front angles of the antennary fossæ are prolonged into small but distinct trabeculæ; there are five long hairs, not four, in the posterior angles of the metathorax, four hairs rising near together in a clear space and the fifth apart and near the lateral margin. I find distinctly in undoubted adult specimens the ten abdominal segments referred to by Taschenberg, who thought his specimens might be immature. The measurements agree well, those of the adult female figured by me being: body, length 2.50 mm., width .56 mm.; head, length .75 mm., width .53 mm. I figure an adult female and a very young.

***Lipeurus toxoceros* Nitzsch.** (Plate x, figs. 3 and 5.)

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1866, vol. xxviii, p. 386.

Lipeurus toxoceros Nitzsch. Giebel, Insecta Epizoa, 1874, p. 237; Piaget, Les Pediculines, 1880, p. 343; Taschenberg, Die Mallophagen, 1882, p. 149, pl. iv, fig. 7.

Lipeurus gyroceros Nitzsch (ed. Giebel), Zeitschr. f. ges. Naturwiss., 1866, vol. xxviii, p. 386.

An adult male and two young taken on two specimens of Farallone Shag, *Phalacrocorax dilophus albociliatus* (Bay of Monterey, California), and one adult male from a California Brown Pelican, *Pelecanus californicus* (Bay of Monterey, California). The pelicans and cormorants congregate in great numbers on the same rocks in Monterey Bay, and it is not surprising to find a straggling individual of this cormorant parasite on a pelican. Nitzsch's specimen was collected on a *Halicus carbo*, and the specimen described by Nitzsch as *gyroccros*, but declared by Taschenberg to be identical with *toxoceros*, was found on *Halicus brasiliensis*.

The adult male figured by me measured as follows: body, length 3. mm., width .8 mm.; head, length .62 mm., width .6 mm.; and the young as follows: body, length 1.9 mm., width .53 mm.; head, length .5 mm., width .5 mm.

Lipeurus squalidus Nitzsch. (Plate x, figs. 6 and 7.)

German's Mag. Entomol., 1818, vol. iii, p. 292.

Pediculus anatis Fabricius, Systema Entomologiæ, 1775, p. 345.

Lipeurus squalidus Nitzsch. Gurlt, in Mag. f. d. ges. Thierheilk., 1842, vol. viii, p. 425; Deuny, Monographia Anoplurorum Britanniae, 1842, p. 176, pl. xiv, fig. 5; Grube, Middendorff's Reise, 1859, vol. ii, p. 486; Nitzsch (ed. Giebel), Zeitschr. f. ges. Naturwiss., 1866, vol. xxviii, p. 385; Giebel, Insecta Epizoa, 1874, p. 241, pl. xvi, fig. 1; Piaget, Les Pediculines, 1880, p. 344, pl. xxx, fig. 5; Taschenberg, Die Mallophagen, 1882, p. 162.

This common species of the ducks has long been known, and is widely distributed geographically and zoologically. It has been taken on at least a dozen species of ducks, and what have been called varieties of it on still other species. The exact defining of *squalidus* has not yet been accomplished. Piaget declares that four resembling species (*sordidus*, *depuratus*, *frater* and *gracilis*) of Nitzsch and Giebel are simply *squalidus*; Taschenberg agrees with Piaget, and adds that Rudow's species, *rubromaculatus*, *punctulatus*, *cinereus* and *nyrocæ*, are, at best, but varieties of *squalidus*.

The evident truth is that the wide distribution of this duck parasite has resulted in the noting of the many variations normal to any animal species whose peculiar habits of life produce the comparative isolation of small groups of individuals. The common occurrence of the parasite and its hosts has resulted in its frequent capture, thus affording opportunity for the examination of many individuals widely separated geographically. It seems to me, under the circumstances, advisable to give a broad defini-

tion of the species, without attempting, as yet, to indicate varieties by name.

I attribute to this species specimens taken from a Bufflehead, *Charitonetta albeola*, Mallard, *Anas bosca*, and a Ruddy Duck, *Erismatura rubida*, all from Lawrence, Kansas. These specimens vary somewhat among each other, and all from the descriptions of Giebel and Piaget, which descriptions in turn do not agree with each other. The markings of the abdomen seem to be extremely variable, ranging from an indistinct lateral brownish coloration to distinct quadrangular, sharply-emarginated lateral blotches. More striking is the variation in number of the long hairs in the posterior angles of the metathorax. Piaget mentions two short ones, Giebel four, while all of my specimens show seven, varying in length and arranged as shown in figure 7, plate x. The specimen which I figure was taken from a Bufflehead, *Charitonetta albeola*, and will serve as a fairly representative illustration of the species for purposes of comparison. The measurements of this specimen are: body, length 3.3 mm., width .62 mm.; head, length .63 mm., width .44 mm.

***Oncophorus advena* n. sp.** (Plate xi, figs. 1 and 2.)

A male and one female taken from the American Coot, *Fulica americana* (Bay of Monterey, California), and a male taken from a Pacific Loon, *Urinator pacificus* (Bay of Monterey, California). Can this last individual be a straggler? The female resembles the female of *Oncophorus minutus* Piaget, and was by me thought to belong to this species until I had found the male, whose appendaged antennæ make it impossible to refer the American specimens to this species. The female also on closer examination differs from the female *minutus* in its distinctly broader abdomen, by possessing four hairs on posterior

angles and margin of metathorax instead of two, and by the absence of an uncolored median abdominal line. The new species by the character of the antennæ of the male belongs to the group *docophoroides*.

The genus *Oncophorus* was established by Rudow (Zeitschr. f. ges. Naturwiss., 1870, vol. xxxv, p. 175) for his *Oncophorus schillingi* since removed by Taschenberg to his genus *Eurymetopus*. Piaget has preserved the generic name *Oncophorus* but applies it to a group of widely removed *Nirmus*-like small forms. Eight species have been described; of which seven are found on wading birds. Piaget says of the genus that it serves as a natural transition between the genera *Docophorus* and *Nirmus* on one side, and *Goniodes* and *Lipeurus* on the other.

Description of the male. Body, length 1.15 mm., width .4 mm.; small, pale with dark brown lateral abdominal bands on all except last three abdominal segments.

Head, length .34 mm., width .32 mm.; front parabolic with a few short hairs rising from the dorsal surface on each side of the middle of the front projecting over the margin; trabeculæ short, wide at base appearing equilaterally triangular in shape; antennæ with first segment much enlarged, third segment with a distinct appendage, fourth shorter than fifth; eye at about middle of the head, flatly convex with a hair; temporal margins straight, diverging posteriorly with three short spiny hairs; in the posterior angles a very long strong hair, reaching to the posterior margin of the first abdominal segment; just behind this hair a spine, and on the occipital margin two short, strong, spiny hairs inserted even with the lateral margins of the prothorax; occipital margin sinuous; color, pale golden; antennal and ocular bands dark, subtranslucent and curving.

Prothorax, subquadrangular with anterior end projecting beneath the head, and anterior margin emarginated, posterior margin weakly convex; a long, strong hair in each posterior angle; pale golden, anterior angles darker. Metathorax not longer than prothorax, wider, with lateral angles rounded and with two long hairs inserted very closely together; on the posterior margin on each side two long hairs inserted very closely together; posterior margin convex and obtusely angulated on the abdomen; pale golden brown, with darker spots on anterior margin near the anterior angles. Legs concolorous with body, or slightly paler.

Abdomen short with subparallel sides, posterior angles projecting slightly, and with two or three rather long hairs; a double longitudinal line of weak hairs along dorsi-meson; lateral bands smoky brown fading out on posterior segments; last segment truncate behind, with a few very short inconspicuous hairs on posterior margin; genitalia distinct, with two backward projecting prongs and two longer forward projecting prongs reaching fourth segment.

Female, body, length 1.28 mm., width .5 mm.; head, length .4 mm., width .4 mm.; head less "square" in appearance, more tapering, temporal margins convex not straight; antennæ with second segment longest, third and fourth equal and fifth slightly longer than fourth; lateral bands of abdomen much more strongly marked and posterior angles of abdominal segments projecting more; last segment of abdomen rounding with slight emargination.

Eurymetopus taurus Nitzsch. (Plate xi, figs. 3, 4, 5 and 6.)

Zeitsch. f. ges. Naturwiss., 1866, vol. xxviii, p. 385 (ed. Giebel).

Philopterus brevis Dufour, Ann. d. l. Soc. Ent. France, 1835, vol. iv, p. 674, pl. xxxi, fig. 3.

Docophoroides brevis Giglioli, Quart. Jour. Mic. Science, 1846, vol. iv, p. 18, pl. i, B, figs. 3, 4.

Lipeurus taurus Nitzsch, Giebel, Insecta Epizoa, 1874, p. 234; Piaget, Les Pediculines, 1880, p. 332, pl. xxxi, fig. 3.

Eurymetopus taurus Nitzsch, Taschenberg, Die Mallophagen, 1882, p. 183, pl. v, figs. 8, 8a.

Many specimens, males, females and young, taken from two specimens of the Short-tailed Albatross, *Diomedea albatrus*, shot on the Bay of Monterey, California. Also found on two out of thirty specimens of the Pacific Fulmar, *Fulmarus glacialis* vars. *rodgersii* and *glupischa*, taken in the Bay of Monterey, California. This species has been found by Nitzsch, Swinhoe, Dufour and Meyer on *Diomedea nigripes*, *exulans* and *brachyura*. The specimens taken by me differ in some slight details from Taschenberg's careful description, notably in the longer and narrower signature and in their much smaller size, both males and females being less than three-fourths as large as the specimens (Nitzsch's) measured by Taschenberg, and about three-fourths the size of Piaget's specimens. The measurements of my figured specimens, as compared with Taschenberg's measurements, are as follows (Taschenberg's figures in parentheses): Male, body, length 3.12 mm. (4.13 mm.), width 1.18 mm. (1.75 mm.); head, length .9 mm. (1.25 mm.), width 1. mm. (1.52 mm.). Female, body, length 3.40 mm. (4.38 mm.), width 1.5 mm. (1.62 mm.); head, length .95 mm. (1.25 mm.), width 1. mm. (1.56 mm.). Taschenberg's figures are in bad shape; he evidently attributes to the male the measurements of the female and *vice versa*, as he makes the male the larger. In the above comparison I have transposed his figures. Also he attributes to the male (= female) a thorax almost twice as long as that of the female (= male)! This is an obvious error. Despite the conspicuous difference in size and a few other minor

ones, I incline to attribute my specimens to Nitzsch's species rather than to call them new.

The blotches on the ventral side of the abdomen of the male, described by Piaget and said by Taschenberg to be wanting on his specimens, are plainly present in mine. As both Piaget and Taschenberg figure the male, I figure the female, the head of the male, and an immature male and immature female. This last shows an interesting stage in the formation of the lateral abdominal blotches, there being two blotches on the lateral portion of each segment, which fuse to form the large blotch of the adult stage. The short round abdomen and peculiar marking of the head are also striking. The measurements of the young female figured are: body, length 2.15 mm., width 1.25 mm.; head, length .65 mm., width .8 mm. The immature but nearly grown male is as large as the adults.

GIEBELIA gen. nov.

By this name (given in honor of Prof. C. G. Giebel) I would designate a *Docophorus*-like form of which several specimens (males and females) of a single species were taken from specimens of the Black-vented Shearwater, *Puffinus opisthomelas*. The distinguishing characters of the new genus are its *Docophorus*-like form, with very short, broad, suborbicular abdomen (in the single species yet known six-sevenths as broad as long); size of body and shape of abdomen same in both sizes; large head; produced rectangular anterior angles of temporal margins with the large eye in the angle; antennæ arising in an antennal emargination; conspicuous trabeculæ, a transparent, semilunar, transversal, membranous flap or process on the forehead with, in the male, a conspicuous, angulated, lateral lobe projecting over the lateral margin of the forehead about midway between the trabeculæ and the

anterior angles of the clypeus, in the female barely produced beyond the margin; strong, obtusely toothed mandibles; labium with short but distinct apraglossæ with five short spines on tip of each; antennæ similar in both sexes; abdomen turbinated, with dark lateral bands and brown transverse bands.

Giebelia (nov. gen.) *mirabilis* n. sp. (Plate xi, figs. 7 and 8.)

Four males and five females taken from six out of seven individuals of the Black-vented Shearwater, *Puffinus opisthomelas*, shot on the Bay of Monterey, California. The only species of *Giebelia* yet found.

Description of the male. Body, length 1.28 mm., width .56 mm.; short, broad (abdomen six-sevenths as broad as long); pale ferrugineous with dark brown to black markings; abdomen with strongly colored lateral bands and paler transversal bands.

Head, length, .45 mm., width .45 mm.; front broad, truncate with very narrow uncolored margin; one short hair in anterior angle; on lateral margin in front of projecting transparent flap two short hairs; lateral projecting part of crescentic, transversal, transparent flap as long as from anterior margin of flap to anterior angle of clypeus; trabeculæ projecting as far as end of first segment of antennæ; antennæ rather long, slender, segments 1-2 about equal, longest, segment 2 shorter, segment 4 shortest, segment 5 almost as long as segment 2, all segments concolorous with head; sutures broadly uncolored; hind head broadly quadrangular; temporal margins subparallel with angulated anterior angles produced, and the large eye with a spine set at the angle; behind the eye a very short hair; farther back a short hair, and then two very long hairs; occipital margin straight,

bare; four dark brown pointed papilla-like processes projecting upwards from dorsal surface of head, one at basal extremity of each antennal band, and one on each side in front of mandible; signature broad extending to mandibles; antennal bands dark brown, angulated, paler along lateral margins of clypeus in front of the flap; mandibles large and strongly colored, forming a broad dark brown transversal line connecting the antennal bands; occipital bands distinct, dark brown, diverging, black at base and biramose; suborbicular occipital signature with two short divergent posterior projections indistinctly showing through from under surface.

Prothorax short, broad; anterior angles, lateral margin and posterior angles rounded; a single hair at posterior angles; a broad, distinct, dark brown, lateral border. Metathorax broad, with angulated lateral margin, a pustulated hair and spine in each angle, and five more hairs, some pustulated and longer than the others, unevenly spaced along the lateral part of convex posterior margin; anterior portion of lateral margin with broad, distinct, dark brown border, with strongly colored process projecting posteriorly into the segment. Sternal markings composed of angulated intercoxal lines between meso- and meta-legs, and two small oblong spots darkest at posterior end on sternum between middle legs. Legs concolorous with body with narrow darker margins, tibiae with three, short, strong spurs on distal extremity opposed to tarsal claws.

Abdomen short, broad, turbinate, with one or more hairs in each projecting posterior angle; a double row of short hairs down the middle of dorsal aspect; well defined, broad, black, lateral bands extending from segment 2 to segment 8, with uncolored stigmatal spots on inner margin of bands; a rather narrow, somewhat sinuous,

brown, transverse bar extending across each segment from lateral band to lateral band; last segment with uncolored anterior angles and broad median blotch; rounded behind with a few short hairs; genitalia extending forward into segment 6, and with most distinct posterior portion (in last two segments) cordate.

Female, length 1.43 mm., width .62 mm.; head, length .5 mm. width .5 mm.; lateral portion of transparent lobe of forehead barely projecting over lateral margin of head; lateral bands of abdomen broadest anteriorly, narrow with inward projecting linear appendages on posterior segments; transverse bands darker in medial portion; last segment broad, flatly rounded.

Colpocephalum unciferum n. sp. (Plate xii, figs. 1, 2 and 3.)

Found on one out of five specimens of the California Brown Pelican, *Pelecanus californicus* (Bay of Monterey, California); and on one out of two specimens of the American White Pelican, *Pelecanus erythrorhynchus* (Lawrence, Kansas). This well marked species shows a resemblance to Giebel's (Nitzsch's) figure of *C. eucarenum* (Insecta Epizoa, pl. xiv, fig. 1), taken from *Pelecanus onocrotalus*, but Giebel's description (p. 276) is, if accurate, of some other species than that to which my specimens belong. Giebel affirms the head to be longer than broad, which is not the case with my specimens, and which would be, as Piaget says, characteristic. I cannot but make my specimens types of a new form.

Description of male. Body, length 2 mm., width .62 mm.; golden brown with dark brown abdominal bands and intense black head markings.

Head, length .44 mm., width .52 mm.; front very flatly convex, almost straight, with, on each side of middle line,

a weak hair, a short thick pointed spine, a shorter hair, two longer hairs, a shorter hair, and in the expansion in front of the ocular emargination four rather stiff longish bristles, the second being the longest; palpi just projecting beyond the margin, and antennæ projecting by all of the last segment which is diagonally truncated; the eye is inconspicuous but double, the anterior half being the more prominent; in the ocular emargination several hairs, and a fringe of short thick-set hairs extending back to the middle of the temporal margin; on the temporal margin several prominent hairs, of which two are very long; occipital margin concave, bare; two large, black, occipital triangles extending forward, and paling and tapering rapidly, as occipital bands; a broad occipital black border connecting the triangles; large, black, ocular blotches, and an uneven, curving, dark brown, inner band, running from the ocular blotches to the frontal margin, the anterior end of these bands expanded and darker.

Prothorax short, angularly elliptical, with a series of seven hairs along each lateral half of the posterior margin, beginning with a short spiny hair in the apex of the lateral angle; whole segment pale golden brown, with a paler narrow transversal blotch in front of the middle. Metathorax short, broad, trapezoidal, lateral margin with short spiny hairs; color pale brown, darker laterally. Legs long, femora thickened, tibiæ slender, expanding distally, especially the tibiæ of the forelegs; tarsi one-half as long as tibiæ; color pale golden brown, with dark brown markings on dorsal aspect of femur and tibiæ.

Abdomen elongate, widest at fourth segment and gradually narrowing in both directions; ends of segments projecting on the sides and armed with stiff, sharp-pointed hairs, especially in posterior angles; segments 6-9 with a pair each of very long hairs; ninth segment broad and

flatly rounded behind, posterior margin with several longish hairs; lateral ends of segments dark brown (dark region quadrangular) and a paler, transverse band running clear across each segment and covering all of its surface, paler in its median portion; sutures paler to uncolored.

Female, length 2.19 mm., width .62 mm.; abdomen rather fusiform in shape, segment 2 the widest; segment 9 elongate, tapering, with a series of six short, strong, recurved hooks on the front half of each lateral margin; posterior margin broadly obtusely angled and thickly beset with stiff hairs; from the middle of each lateral segmental margin arises a pair of long hairs; the lateral margins of the abdomen are darker, black in some specimens, than in the male.

An immature specimen, 1.56 mm. long, showed as its only markings the ocular blotches, the anterior ends of the inner bands and a short linear marking on occipital margin; all of these markings were distinct and black.

Colpocephalum uniforme n. sp. (Plate xii, fig. 4.)

A single female taken from an American Avocet, *Recurvirostra americana* (Lawrence, Kansas). This species closely resembles *grandiceps* Piaget (Les Pediculines, p. 558, pl. xlvii, fig. 7), taken on *Hæmatopus ostralegus*, but differs from it in the number and arrangement of the long hairs on the head, thorax and last abdominal segment, and in the markings.

Description of female. Body, length 2.34 mm., width .75 mm.; elongate, pale golden brown, with very little darker markings; the small ocular blotches, occipital margin, and narrow lateral margin of metathorax and abdomen black.

Head, length .4 mm., width .6 mm.; ocular emargination less deep than usual; front rounded, almost a semi-

circle, the contour being slightly irregular because of a small, medial, angled projection, and a shallow almost imperceptible concavity behind the slight but distinct, obtuse, anterior angles; four hairs between the medial frontal angle and the latero-anterior angle of which the last hair is the longest, a very short hair in the anterior angle and a hair just in front of the projecting palpus tip; four hairs, of which one is long, in the lateral angle in front of the ocular emargination; the eye large with a slight emargination, the front half projecting further than the posterior half; the hairs of the ocular fringe larger than usual, the fringe extending but slightly on the margin of the broad temporal region; temporal margin with three long hairs and several short ones; occipital margin concave, bare. Color of head pale golden brown, with small black ocular blotches and narrow black border on outer temporal and occipital margins; indistinct narrow brown occipital bands, the black occipital margin expanded at their bases.

Prothorax with a spine and long hair in produced lateral angles, and a number of long hairs in obtuse latero-posterior angles; the posterior margin seems to be bare; golden brown with small latero-anterior dark brown blotches and very narrow dark brown border between lateral and latero-posterior angles. Metathorax showing no marginal constriction at line of union of meso- and metathorax; sides bare; produced posterior angles with two long hairs and two stout spines; posterior margin straight, bare; whitish, with narrow dark brown to black lateral border expanded slightly in anterior angles. Legs concolorous with body with very narrow dark brown dorsal margins of femora.

Abdomen elongate with long hairs in posterior angle of segments, and short hairs along lateral margins; a nar-

row interrupted (by sutures) black marginal band, and faint golden brown, broad, transverse bands darker on posterior segments; last segment slowly tapering, broad and flatly convex behind, with transparent margin and fringe of fine sharp-pointed hairs.

The specimen is probably not adult, and the markings consequently less extensive than those of the adults.

Colpocephalum pingue n. sp. (Plate xii, fig. 5.)

Two males taken from one of the two specimens of the Short-tailed Albatross, *Diomedea albatrus*, shot on the Bay of Monterey, California. No *Colpocephalum* has hitherto been taken on an Albatross.

Description of male. Body, length 1.7 mm., width .62 mm.; short, broad, fuscous, with dark brown abdominal transverse bands, paler medially.

Head, length .28 mm., width .5 mm.; but little more than half as long as wide; front flatly rounding, with, on each side of the middle which is marked by a minute angular process, a short weak hair, a longer stiff spiny hair, then another similar one (adjacent to the projecting palpus), and on the lateral angle in front of the ocular emargination four hairs, of which two are the longest of the forehead hairs; the palpus and antenna projecting beyond margin, each by its last segment; the eye large, simple, filling the base of the ocular emargination and containing a distinct, divided, black fleck; the ocular fringe of hairs extending only to the posterior limit of the emargination; the temporal margin convex and with eight hairs of which three are long; occipital margin weakly concave with two hairs on each side of the middle. Color of head fuscous with a narrow black occipital margin expanded at the bases of the faintly discernible occipital bands; the ocular blotches large, black, extending along

the posterior margin of the emargination as a narrow black border, and still more narrowly and unevenly margining the temporal region; the inner bands indistinct, chestnut brown.

Prothorax broad (three-fourths as broad as head), short, posterior border rounded with a series of seven strong hairs beginning in the apex of the lateral angle; color pale yellowish brown. Metathorax short, broad, expanding rapidly posteriorly, anterior angles rounded, posterior angles produced, acute, with a short spine and a strong, long hair which is the terminal one of a series ranged along the straight posterior margin of the segment; sides bare. Color of prothorax light brown with a narrow dark brown or black uneven marginal blotch and a broad and transverse band of fuscous. Legs concolorous with body, with dark fuscous markings.

Abdomen broadly ovate, posterior angles of segments slightly projecting with one or two strong hairs and adjacent short ones; a series of strong hairs along posterior margin of each segment, and numerous other shorter hairs; each segment except last with a lateral marginal curving black blotch produced inwardly; also a transverse fuscous band extending entirely across each segment paler medially and darker on segments 7 and 8; ninth segment large, broad, rounded behind, posterior margin with two pairs of strong hairs on each side of the middle, whole segment uniformly fuscous.

Colpocephalum timidum n. sp. (Plate xii, fig. 6.)

Two females from a Golden Plover, *Charadrius dominicus* Lawrence, Kansas. The new species resembles *ochraceum* Nitzsch (Germar's Mag. Entomol., 1818, vol. iii, p. 299), somewhat.

Description of female. Body, length 1.94 mm., width

.37 mm.; pale brown, with small black markings on head and thorax, and dark brown markings on abdomen.

Head, length .36 mm., width .53 mm.; palpi not projecting, antennæ slightly projecting; front bare; lateral margin in front of ocular depression with four hairs of which one is long; eye with slight but distinct emargination; ocular fringe distinct; temporal margin with four long hairs, of which one, the third, is very long, and a few short hairs; occipital margin concave; pale yellowish brown, with small dark brown to black ocular blotches, and narrow occipital border expanded at bases of the very faint occipital bands.

Prothorax, with spine and hair on lateral angles, and close to the angle on latero-posterior border a hair; in latero-posterior angles a single hair, and along rounded posterior margin two very short hairs and two longer ones; without dark markings, although the lateral angles and borders appear darker because of sternal markings showing through; also the median sternal blotch faintly showing through. Metathorax with angular emargination on sides showing line of fusion of meso- and metathorax; anterior angles rounded; sides bare; posterior angles with a spine and two strong hairs; anterior angles bordered with black; lateral margins unevenly bordered with brown in which there is on each side a short linear black mark cutting off the region of the posterior angles. Sternal markings consisting of a median blotch on prothorax, a paler and more indistinct large median blotch on metathorax, and dark intercoxal lines. Legs concolorous with body; all femora thickened.

Abdomen, nowhere strongly colored or marked; an uncolored longitudinal line running parallel with each lateral margin on segments 1-8; outside of this line on each segment an ill-defined fuscous blotch showing as its

most distinct portion a short transverse line, especially noticeable on segments 1-6; the posterior angles of the segments, which hardly project, bear each a long hair, a very few scattered small hairs on lateral margin; numerous short non-pustulated hairs scattered over the surface of the body; last segment pale with two longish lateral marginal hairs, and convex behind with a short fringe of fine transparent hairs. -

Colpocephalum funebre n. sp. (Plate xii, fig. 7).

Two females from two specimens of the Glaucous-winged Gull, *Larus glaucescens*, Bay of Monterey, California. This species resembles *fuscipes*.

Description of female. Body, length 3.1 mm., width 1.5 mm.; large with comparatively small head and thorax; dark brown, with black markings.

Head, length 5 mm., width .78 mm.; palpus barely or not at all projecting beyond margin of forehead; antenna projecting slightly; front flatly rounded with eleven hairs on each side between middle of front and ocular emargination, of those on the true front the second and fifth longer than the others and of those on the side one very long; ocular emargination deep, narrow; eye large, simple, hemispherical, the ocular fringe prominent; of the hairs on the temporal margin four are long; occipital margin not deeply concave, bare; color dark brown with a narrow black border extending more or less distinctly entirely around the head; on the sides of the forehead the border is broken into spots, and along the front it is sinuate and is narrowly margined in front by a pale, almost uncolored space; on each lateral region of the forehead there are three small circular uncolored spots from each of which arises a short hair; on under side of head, a distinct large occipital signature; narrow oc-

cipital bands bending outward anteriorly, and a narrow black line bounding the oral fossa.

Prothorax, narrow, short; lateral angles obtuse, produced, and with a spine and long hair; in latero-posterior angle a long hair, and in addition two posterior marginal hairs on each side of the middle; color dark brown with narrow black lateral border, and a very narrow transverse line across the segment in front of the middle. Metathorax, sides bare, posterior angles with two spines and a long hair; posterior margin with a few hairs; color dark brown with darker irregular broad lateral border and large trapezoidal median blotch (sternal marking showing through) limited to metathorax; a distinct paler-colored sutural line between meso- and metathorax, with slight angular emargination on the sides; mesothorax with a paler-colored narrow median line separating the dark quadrangular lateral blotches. Sternal markings consisting of a median irregularly octagonal blotch on prothorax, behind it a Y-shaped line running across mesothorax and connecting with a large pentagonal metathoracic blotch with apex directed anteriorly; in addition broad lateral and coxal borders. Legs long, fore femora greatly thickened, middle femora not so much so and hind femora but little thickened; with scattered prominent hairs; concolorous with body.

Abdomen, very large, elongate oval, with one long hair in posterior angles of segments and several short ones along sides and in angles; a series of about twenty pustulated hairs along posterior margin of segments 1-7; these series extending laterally only to a pale-colored longitudinal line running parallel with the lateral margin of body and about .16 mm. from it. Color dark brown, with narrow black lateral border interrupted by sutures; and extending in on each segment along posterior margins

to the pale longitudinal line, and along anterior margin not quite to this line; broad transverse bands extending across each segment between the pale longitudinal lines; last segment with three blotches and rounded, hair-fringed posterior border.

***Colpocephalum laticeps* n. sp.** (Plate xii, fig. 8.)

A single male specimen from an American Egret, *Ardea egretta* (Lawrence, Kansas). This small and well-marked species cannot be referred to any one of the *Colpocephali* described by Nitzsch from various species of *Ardea*.

Description of male. Body, length 1.72 mm., width .72 mm.; dark golden brown, abdomen with distinct dark fuscous transverse bands.

Head, length .31 mm., width .62 mm.; just twice as wide as long; front broadly rounded with hairs on each side of the middle, as follows: a very short one, another and another, all some distance apart, and in the lateral angle in front of the ocular emargination four, of which two are long; the eye undivided but with a faint medial emargination and with a single black fleck in it; the ocular fringe not extending on the temporal margin; this margin with several short, fine, stiff hairs and three unevenly long pustulated ones; also a long pustulated hair arising from nearly the center of the temporal region; occipital margin not deeply concave, with four hairs; color pale smoky brown, ocular blotch black, bordered irregularly with dark smoky brown which extends backwards as an indication of occipital bands and forward as a suggestion of inner bands; temporal margin narrowly bordered with blackish brown; occipital margin narrowly bordered with black, widest along middle third of head.

Prothorax comparatively long and narrow (the width is always greater than the length among the *Colpocephali*),

with conspicuously obtusely produced lateral angles bearing a spine and a long hair; the lateral margin between this lateral angle and the rounded posterior angle slightly concave and bare; posterior angle with a long hair followed by a short stiff hair, and by three long pustulated hairs along each half of the posterior margin; color fuscous with a darker, narrow, transverse line before the middle, and two similarly colored, narrow, curving lines running subparallel with the lateral margins. Metathorax trapezoidal, with posterior angles projecting beyond the sides of the abdomen; these angles with some short stiff hairs and the first of a series of ten long hairs ranged along the posterior margin; lateral margins bare and with a slight constriction in front of the middle indicating the line of fusion of meso- and metathorax; color fuscous with darker, almost black, triangular blotch in posterior angles, and a rather broad, pale, almost uncolored transverse line at line of fusion of meso- and metathorax.

Abdomen rather broadly elliptical with projecting ends of segments; one long and several shorter hairs on each posterior angle, and a series of about twelve hairs along the posterior margin of each segment. Color pale at sutures, black interrupted (by sutures) lateral bands, and a dark brown transverse band extending entirely across each segment; ninth segment broadly rounded behind with narrow transparent margin thickly set with a fringe of short sharp-pointed transparent hairs.

Ancistronea gigas Piaget. (Plate xiii, figs. 1 and 2.)

Les Pediculines, Supplement, 1885, p. 117, pl. xii, fig. 8.

Several specimens, ♂, ♀ and ☉, of this remarkable form from four individuals of the Pacific Fulmar, *Fulmarus glacialis* vars. *rodgersii* and *glupischa* (Bay of Monterey, California). Piaget described the species from a single

female taken from *Procellaria glacialis*. His description is excellent. The males differ from the females very little, the recognizable character being the hairless condition of the posterior border of the last abdominal segment. On each lateral margin of this segment there is a small group of short uncolored hairs, rather thick at base. I figure the male and an immature specimen. The immature specimen is without markings, except for a black fleck in the posterior angle of head, and a weak indication of the prothoracic lines. The head and thorax are of pale brownish, the abdomen whitish tinged with buffy. The measurements of the specimens figured are as follows: Male, body, length 5.5 mm., width 2.65 mm.; head, length .7 mm., width 1.87 mm. Young, body, length 2.6 mm., width 1.2 mm.; head, length .5 mm., width 1. mm.

Trinoton lituratum Nitzsch. (Plate xiii, fig. 3.)

Germar's Mag. Entomol., 1818, vol. iii, p. 300.

Trinotum lituratum Nitzsch, Burmeister, Handbuch d. Entomologie, vol. ii, p. 441; Giebel, Insecta Epizoa, 1874, p. 260, pl. xviii, fig. 10.

Trinoton squalidum Denny, Monograph. Anoplur. Brit., 1842, p. 235, pl. xxii, fig. 3; Giebel, Insecta Epizoa, 1874, p. 259.

Trinoton lituratum Nitzsch, Piaget, Les Pediculines, 1880, p. 597, pl. xlix, fig. 7.

A few specimens taken from the Pintail, *Dafila acuta*, and the Buff-breasted Merganser, *Merganser serrator* (Lawrence, Kansas). Nitzsch's original specimen was found on *Mergus albellus*, and Denny's specimens were taken from *Anas clypeata*. Piaget found the species on *Dendrocygna arborca* and *Anser albifrons* (Zool. Garden of Rotterdam). The species is easily recognized by its short broad outline and its markings. The female figured by me measured as follows: body, length 2.1 mm., width .63 mm.; head, length .5 mm., width .63 mm.

Trinoton luridum Nitzsch. (Plate xiii, fig. 4.)

German's Mag. Entomol., 1818, vol. iii, p. 300.

(Louse of the Teal) Redi, Experimenta circa gen. Insectorum, 1686, pl. xii (or x?); Albin, Nat. Hist. of Spiders and other curious insects, 1736, pl. 46 (or 48?).

Trinotum luridum Nitzsch. Burmeister, Handbuch. d. Entomologie, vol. ii, p. 441; Giebel, Insecta Epizoa, 1874, p. 258, pl. xviii, fig. 7.

Trinoton luridum Nitzsch. Denny, Monograph. Anoplur. Brit., 1842, p. 234, pl. xxii, fig. 2; Piaget, Les Pediculines, 1880, p. 591, pl. xlix, fig. 3.

Trinoton gracile Grube. Middendorff's Reise, vol. i, p. 494, pl. ii, figs. 6 and 6a.

Trinoton conspurcatum Nitzsch. Gurlt, in Mag. f. d. ges. Thierheilk., vol. viii, p. 430, pl. iv, fig. 15.

I have taken this common parasite of ducks from the Shoveler, *Spatula clypeata*, the Buff-breasted Merganser, *Merganser serrator*, the Greenwinged Teal, *Anas carolinensis*, the Pintail, *Dafila acuta*, the Mallard, *Anas boscas*, the Widgeon, *Anas americana* (Lawrence, Kansas), and from the Ruddy duck, *Erismatura rubida* (Monterey, California). There is, as has already been said by Piaget, a considerable variation in the individuals of this species, especially in the extent and intensity of the abdominal markings. It seems hardly worth while in the present state of knowledge of the Mallophaga to attempt to indicate these varietal differences by name. The size varies somewhat markedly among individuals and the males are smaller than the females. The following are the measurements of two specimens, one a male taken from a Pintail, *Dafila acuta* (Lawrence, Kansas), and the other, whose measurements are enclosed in parentheses, a female (the specimen figured by me) taken from a Ruddy Duck, *Erismatura rubida* (Monterey, California): Body, length 4.3 mm. (5. mm.), width 1.19 mm. (1.56 mm.); head, length .7 mm. (.8 mm.), width 1. mm. (1.28 mm.).

An immature specimen taken from a Greenwinged Teal, *Anas carolinensis* (Lawrence, Kansas), is almost as large as the average adult, but is uniformly pale, faintly tinged with clear brownish, showing no markings except a distinct black ocular fleck and the brown mandibles. The dimensions of this specimen are: Body, length 4.5 mm., width 1.43 mm.; head, length .81 mm., width 1.28 mm.

Læmobothrium similis n. sp. (Plate xiv, figs. 1 and 2.)

A single specimen from an Eared Grebe, *Colymbus nigricollis californicus* (Lawrence, Kansas). This species is very like Piaget's *emarginatum* (Les Pediculines, 1880, p. 585, pl. xlviii, fig. 8), taken from *Gallinula hæmatopus* (Zool. Garden of Rotterdam), but lacks the occipital bands of the head, has more of the peculiar, short, flattened, stiff points on the front margin of the head, has a very differently shaped prothorax (if Piaget's description and figure are accurate), lacks the strong markings of emargination, and is a slightly larger species. My specimen is probably not adult, but is of not earlier stage than the last nymphal one. Adult specimens will measure a little larger, and will be a little more strongly marked. This genus has not before been found on a pygopodous bird.

Female, body, length 4.4 mm., width .87 mm.; uncolored (weakly pale brownish) with narrow, sharp, brown markings on head and thorax.

Head, length 1. mm., width .78 mm.; ocular emargination slight, contraction of sides of head even with the mandibles strong, sides of forehead slightly converging; front with rounding emargination, angles rounding; on each side of the center of the emargination toward the angle are a short hair, a longer hair arising from ventral surface, two short flattened spines, and projecting over

the margin between them a hair arising from the dorsal surface, a long hair, a very short weak hair, and beyond the apex of the angle two flattened spines, the second one longer, and a long hair; the front half of the convex margin of the antennal fossa bears one very long hair and four shorter hairs, and the hinder half three weak, equal hairs arising close together and projecting backwards; the temporal margins bear two long hairs and more than a dozen short, equal ones; occipital margin concave; eyes double, inconspicuous; antennæ concealed in fossæ but showing through, fourth segment subglobular; labial palpi, with thick segments of about equal length, third and fourth segments with a short hair at anterior outward angle; mandibles pale brown with teeth dark brown; ocular flecks black; antennal fossæ rimmed with brown and a curved band, convex behind, across the head between middle points of antennary fossæ; a narrow, long, pale brown triangle projecting back from middle of transverse curving band just described; no occipital bands; in front of mandibles a rounding, pointed, crescent-shaped fossa, convex anteriorly.

Prothorax, subquadrangular, with a narrow anterior neck-like portion which fits into the occipital concavity of the head, sharply set off by a constriction; the posterior margin deeply and broadly emarginate, leaving the posterior angles as obtusely pointed, backward projecting processes underlying the metathorax; behind the frontal constriction the margin is angulated and a long hair and a short one rise from the angle; two black flecks on the frontal margin, a black fleck on each side of the constriction, and a brown lateral marking extending a little way along the middle of the margin. Metathorax and mesothorax continuous in outline with the abdomen; mesothorax indicated by a very slight narrowing near the front

of the combined segments; three longer hairs and seven short ones along the margin of the segment; two brown flecks on front margin, and the rounding anterior angles narrowly and weakly margined with brown. Legs, uncolored, except for pale brown at extremities of segments, and very narrow marginal lines; front margins of femora of middle and hind legs with four or five subequal prominent hairs and several very short ones.

Abdomen, parallel-sided for anterior half and then gradually tapering posteriorly; no marginal constrictions between segments; but one or two long hairs in each posterior angle; last segment with one strong long hair and one longer, weaker hair in each posterior angle and a series of six short, equal hairs along posterior margin; margin narrowly lined with pale, clear brownish, and within a parallel, narrow, uncolored line.

***Læmobothrium atrum* Nitzsch.** (Plate xiv, fig. 3.)

Germar's Mag. Entomol., 1818, vol. iii, p. 302.

Pulex fulicæ Redi, Experimenta circa generationem Insectorum, 1686, pl. iv, fig. 1.

Læmobothrium nigrum Burmeister, Handbuch d. Entomologie, 1832, vol. ii, p. 442.

Læmobothrium atrum Nitzsch, Denny, Monograph. Anoplur. Brit., 1842, p. 240; Giebel, Insecta Epizoa, 1874, p. 253, pl. xviii, fig. 5; Piaget, Les Pediculines, p. 586.

A single specimen from an American Coot, *Fulica americana* (Monterey, California). The previously taken specimens have been found on *Fulica atra*, also probably one occurrence on *Podiceps rubricollis*. The descriptions vary somewhat and are incomplete, and Giebel's figure shows strange markings of head and thorax, but the large size and dark coloration of the entire body sufficiently identify the species. Giebel's measurements are far under those of my specimen, which are: body, length 8 mm., width 1.9 mm.; head, length 1.4 mm., width 1.17 mm.

Menopon navigans n. sp. (Plate xiv, figs. 4 and 5.)

Two males and a young female taken from a Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). Piaget has found a *Menopon* (*affine*, Tijdschr. voor Ent., 1890, vol. xxxiii, p. 248, pl. x, fig. 3) on an Albatross (*Diomedea exulans*, a skin in the Leyden Museum), but my new species does not resemble *affine* particularly. *Affine* is a smaller species, with a head more than three-fifths as long as broad; the head of the new species is twice as wide as long.

Description of the male. Body, length 1.8 mm., width .75 mm.; head and thorax pale with dark brown markings; abdomen with large, brown, transverse bands, subparallel-sided; many long bending hairs.

Head, length .34 mm., width .66 mm.; semilunar, front with, on each side, three hairs (of which the second is not strictly marginal), then a very short prickle, then five hairs in front of the ocular region, of which three are long; palpi and antennæ projecting by the length of their terminal segments; temporal margin with two very long hairs, one half as long, two one-fourth as long, and a few short ones; occipital margin concave with four hairs on the middle third. Color, pale brown, darker medially, and with black ocular blotches, and a linear, black, occipital border.

Prothorax broad, short, with lateral angles much produced and bearing two long hairs and a spine; posterior margin flatly convex with ten hairs; color pale with a brown transverse line and brown lateral angles darkest outwardly, the margin of the latero-posterior sides being black. Metathorax short, as broad as prothorax, pentagonal, posterior margin straight with a series of hairs closely set, anterior angles and lateral borders expanding in posterior angles, black; a broad transverse brown band like

those of abdomen, in front of which a narrow whitish space broadest medially. Legs concolorous with pale ground color of body, with hairs and thickened femora.

Abdomen oblong, with convex sides and ends, all the segments except 9 being of approximately equal width; especially long hairs in posterior angles and shorter hairs on surface; each segment except 9 with broad transverse brown band covering nearly whole surface of segment and darkest along posterior margin; lateral extremities of bands dark brown to black, forming narrow interrupted lateral bands; segment 9 wholly colored, paler than transverse bands, large, rounding with numerous long hairs.

Menopon indistinctum n. sp. Plate xiv, figs. 6 and 7.)

Two females taken from an American Avocet, *Recurvirostra americana* (Lawrence, Kansas). This species most clearly resemble *crocatum* Nitzsch (ed. Geibel, Zeitschr. f. ges. Naturwiss., 1866, vol. xxviii, p. 392), from a *Numenius arquata* and *Hæmatopus ostralegus* (Piaget), but there are differences quite as considerable as those which have been used by Giebel and Piaget to separate the various *Menopon* species found on the shore birds. *Crocatum*, *lutescens* et. al. ought, perhaps, to be grouped together as a single species with several varieties, as is done for *Docophorus communis*, the common *Docophorus* of the passerine birds. However I add this species from our Avocet to the group which must sometime be well revised. The noticeable differences between this new species and *crocatum* lie in the number and disposition of the hairs of the head and thorax. The species does not at all resemble Nitzsch's species from the European Avocet, *Recurvirostra avocetta* (*micrandum*, Zeitschr. f. ges. Naturwiss. ed. Giebel, 1866, vol. xxviii, p. 392), which has a thorax without hairs, and an abdomen with uncolored longitudinal lines.

Description of female. Body, length 1.80 mm., width .7 mm.

Head, length .28 mm., width .5 mm.; semilunar; twice as wide as long, front with two short hairs at the middle, and on each side in front of the ocular region two short hairs and a long one; palpi slightly projecting; ocular margin straight or very faintly concave; temporal margin with four long pustulated hairs and several short ones; occipital margin concave with one long pustulated hair on each side; head golden brown with fuscous clouding, occipital margin and ocular fleck black; curving line bounding inwardly the antennal region black inwardly shading into dark brown outwardly; a transversal line even with the mandibles and expanded at outer ends, dark brown.

Prothorax, seven-eighths as broad as head, lateral angles very obtusely rounded, almost truncate, with two spines and a long hair; behind the angle on latero-posterior side a spine, then two hairs, and on the straight posterior margin three hairs on each side of the middle; color smoky brown with a distinct transverse darker line in front of the middle and not reaching the lateral margins; outside of each end of this line a short, slightly curving, longitudinal, dark line; the latero-posterior sides narrowly edged with black. Metathorax just as wide as head, narrow anteriorly with rapidly diverging sides, mesothorax distinctly separated by marginal constriction and dark transverse line; posterior angles of mesothorax bare, sides of meso- and metathorax bare; posterior angles of metathorax with a spine and the terminal one of a series of hairs ranged thickly along the weakly convex posterior margin; metathorax with a broad, transverse, fuscous band across posterior half. Sternal markings composed of small median blotch on prothorax with lateral linear processes; a

small pointed blotch with two diverging very small linear processes projecting anteriorly, the whole between strongly curving, inwardly produced intercoxal lines, on mesothorax; and a larger median blotch, truncate behind, convex before, with two small linear points near the posterior angles of median blotch, on metathorax; a smaller semilunar median blotch on first segment of abdomen is also apparaent; the blotches of metathorax and first abdominal segment are beset with numerous short pustulated hairs. Legs pale smoky brown, with darker markings.

Abdomen, elongate oval, posterior angles of segments 1-3 projecting a little; the others barely or not at all; a rather long hair and some shorter ones in each angle; also a series of hairs in small pustulations along the posterior margin of each segment; all segments with a broad, distinct, light fuscous, transverse band whose extreme outer margins are darker; the bands separated by wide, uncolored, sutural lines; last segment, broad, short, uncolored, posterior margin concave with a series of fine short hairs.

Menopon numerosum n. sp. (Plate xv, fig. 1.)

An abundant parasite of the Pacific Fulmars, *Fulmarus glacialis* vars. *glupischa* and *rodgersii*, taken on twenty-four out of thirty specimens shot on the Bay of Monterey, California.

Description of male. Body, length 1.44 mm., width .62 mm.; pale yellowish to reddish brown, with transverse abdominal bands, separated by broad, white, sutural bands.

Head, length .28 mm., width .50 mm.; front very obtusely but distinctly angled with two short hairs on each side of the median angle; three long hairs and three short ones before the slight ocular emargination; a sparsely set

ocular fringe of short stiff hairs, and in the temporal angles four long hairs and several short ones; occipital margin broadly and shallowly concave and with four hairs; dark brown ocular blotches, distinct black flecks in the eyes, and a narrow, dark brown, occipital border.

Prothorax with posterior margin broadly and evenly rounded with fourteen long hairs in a series extending from lateral angle to lateral angle; a narrow transverse line in front of the middle and a short longitudinal line at each end of the transverse line; the lateral angle regions slightly darker than rest of segment. Metathorax with diverging sides, straight or very flatly convex posterior margin; along the sides three short spines, of which the first two project upwards and the third outwards beyond the margin; in the posterior angles are two long hairs, then a short spine, and then a series of twelve long, strong hairs ranged along the posterior margin. Legs concolorous with body.

Abdomen elongate ovate, with long hairs in the posterior angles of segments and a series of long hairs along the posterior margin of each segment; ground color whitish showing in broad, transverse sutural bands; each segment with a pale, reddish brown, transverse band, darker and with a subtransparent, curving space at each end; posterior margin of last segment smoothly rounded with a few rather long weak hairs.

Female larger, length 2. mm., width .78 mm.; head, length .3 mm., width .53 mm.; abdomen more elongate, last segment less broadly rounded, and with a narrow, transparent, posterior border thickly fringed with fine transparent hairs.

Menopon infrequens n. sp. (Plate xv, fig. 5.)

A single female taken from a Glaucous-winged Gull, *Larus glaucescens* (Bay of Monterey, California).

Description of female. Body, length 2 mm., width .81 mm.; brown with chestnut, transverse abdominal bands, narrow black lateral bands, and broadly linear, diagonal, black, ocular blotches.

Head, length .31 mm., width .62 mm., thus being just twice as wide as long; brown with darker fuscous clouds; narrow black occipital margin; black ocular blotches in the form of diagonal bars; some indefinite pale to uncolored spaces, as in the posterior angles, along the front, and a more definite circular space containing a long hair and a spine on each side of the forehead just outside of the origin of the labial palpi; on the front four short hairs near the middle, and on the sides in front of the ocular region two short hairs and one longer but weak hair; temporal angles with three long hairs, one one-half as long and some shorter hairs; occipital margin with four pustulated hairs; on ventral aspect occipital bands showing, enclosing an orbicular occipital signature, with a series of five pustulated hairs along the lateral margins.

Prothorax, with fourteen long, pustulated hairs extending in series from lateral angle to lateral angle along the posterior margin, which in its middle third is almost straight; ground color of segment largely clouded with fuscous to dark brown, especially in lateral angle region, which is very narrowly margined with black; the usual transverse line in front of middle with curving longitudinal lines at the ends especially distinct. Metathorax with lateral emargination and dark brown sutural lines separating mesothorax; posterior margin straight, with a series of not very long hairs, and two or three hairs and a spine in the posterior angles; a fuscous transverse band across posterior half of

segment, with its lateral margins black. Sternal markings composed of a small trapezoid on prothorax with the posterior angles produced, and a broad blotch on metathorax; the anterior coxæ are produced forward and backward into broad lobe-like appendages, rounded in front and angulated behind. Legs concolorous with ground color of the body, with darker margins.

Abdomen, elongate ovate, with one long hair and several short ones rising on margin just in front of each uncolored posterior angle, and a series of hairs along posterior margins of segments; segments 1-8 with a broad, transverse, fuscous band darker at lateral extremities and black on extreme lateral margins; segment 9 uniformly colored, broadly rounded with narrow, uncolored, fringed, posterior margin.

Menopon loomisii n. sp. (Plate xv, fig. 6.)

Specimens taken from two specimens of the White-winged Scoter, *Oidemia deglandi* (Bay of Monterey, California). Named after Mr. Leverett M. Loomis, Curator of Birds, California Academy of Sciences.

Description of female. Body, length 1.8 mm., width .84 mm.; pale golden brown to pale chestnut brown.

Head, length .3 mm., width .56 mm.; semilunar with evenly rounding front, shallow ocular emarginations, and rounded posterior angles; occipital margin concave; palpi projecting by the length of the last segment; the antennæ when outstretched projecting beyond the margin of head by the length of the last segment; a pair of very small hairs in middle of front, a longer one on side followed by a very short one, and then two or three longer ones in front of the emargination; the ocular fringe composed of few but rather strong hairs longer than usual; temporal margins with three very long hairs and two more on occipital margin of the produced temples; four addi-

tional hairs on the occipital margin; a small, black, ocular fleck, dark brown ocular blotch, the mandibles black-tipped, the other mouth-parts and the basal segments of the palpi brown.

Prothorax with produced lateral angles obtuse, bearing two spines and a long hair, which is the terminal one in a series of fourteen ranged along the rounded posterior margin of the segment; the transverse line with curving vertical lines at its extremities is distinct. Metathorax with divergent sides, not quite as wide as head, with flatly convex posterior margin bearing a series of long hairs; in each lateral angle several small spines and the terminal hair of the posterior series. Legs concolorous with body; with scattered, rather long hairs.

Abdomen ovate, with broad transverse bands across all segments separated by wide uncolored sutures; in the anterior angles of each transverse band a small curving comma-like chitinous band; the segments with fine hairs on lateral margins, and longer weak hairs in the posterior angles; dorsal surface with hairs.

Menopon titan Piaget. (Plate xv, fig. 2.)

Les Pediculines, 1880, p. 503, pl. xl, fig. 7.

Tetraophthalmus chilensis Grosse, Zeitschr. f. wiss. Zool., 1885, vol. xlii, p. 530.

Many specimens of this species, or of a variety, found on four of five specimens examined of California Brown Pelican, *Pelicanus californicus* (Bay of Monterey, California), and on the White Pelican, *Pelicanus erythrorhynchus* (Lawrence, Kansas). These large conspicuous parasites are found not alone among the feathers of the host but also abundantly clinging to the inner surface of the gular pouch, a circumstance which suggests that feathers may not constitute the exclusive food of the parasites.

Piaget has described two species of these giant *Menopons* of the Pelicans, viz.: *titan* found on *Pelecanus ono-*

crotalus (Zool. Garden of Rotterdam) and *consanguineum* (Les Pediculines, Supplement, 1885, p. 116, pl. xii, fig. 7) found on *P. erythrorhynchus* (dried skin in Museum of Leyden). Picaglia has described a third species *ragazzi* (Atti d. Soc. d. Nat. d. Modena, 1885, serie iii, vol. ii) found on *P. trachyrhynchus* (Callao), and has established the subgenus *Piagetia* for the group. The characters of the subgenus are as follows: "abdomen narrow and very elongate; male longer than female; length more than 5 mm." The remaining members of the genus *Menopon* present in contrast these characters: "abdomen oval-elongate, rounded oval, or almost round; male smaller than the female; length varying from 1 to 3 mm." The species chiefly used by Franz Grosse in his study of the anatomy of the Mallophaga was a member of this *Menopon titan* group, taken from a Pelican, undetermined, from Chile.

It certainly seems advisable to indicate the peculiar characters of the group by assigning to it a subgeneric name; but I can hardly recognize in Picaglia's description of *ragazzi* characters other than the dimensions which make it recognizably distinct from *titan*. My specimens from *Pel. erythrorhynchus* show the slight variations from *titan* indicated by Picaglia in his description of *ragazzi*, but the dimensions are quite as large as those of *titan* (Picaglia made *ragazzi* one-fourth shorter than *titan*)! My specimens from *Pel. californicus* closely correspond with Piaget's description of *titan*, except that the transverse abdominal blotches are not bifurcated at the extremities. I believe that the present knowledge of the group hardly justifies any separation of the known forms into distinct species, but that the presence of these variations may be recognized by letting *titan* stand as the representative form of the species (*consanguineum* is evidently a distinct species, the equality in size of both sexes re-

moving any likelihood of confusing it with *titan*), and by designating *ragazzi* and my specimens as varieties presenting the following diagnostic characters:

Var. *ragazzia* Picaglia, from *Peleceaus trachyrhynchus* (Callao); small, length of male 3.42 mm., of female 3.15 mm.; mesothoracic suture indistinct; metathorax a little wider than the head; general color paler than *titan*.

Var. *impar* Kellogg, from *Pelecanus erythrorhynchus* (Lawrence, Kansas); with the minor differential characters of *ragazzi*, but almost as large as *titan*; length of male 4.7 mm., of female 3.8 mm.

Var. *linearis* Kellogg (Plate xv, fig. 2), from *Pelccanus californicus*; about same size as *titan*; length of male 5.2 mm., of female 4.2 mm.; transverse abdominal blotches not bifurcated at extremities, and the longitudinal uncolored lines beyond spiracles very distinct in female, forming an interrupted, uncolored, longitudinal line for full length of abdomen, setting off lateral abdominal bands which are darker than the other abdominal markings.

Menopon tridens Nitzsch. (Plate xv, figs. 3 and 4.)

? Germar's Mag. Entomol., 1818, vol. iii.

Lamobothrium tridens Nitzsch. Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1866, vol. xxviii, p. 396.

Menopon scopulacorne Denny. Monograph. Anoplur. Brit., 1842, p. 221, pl. 18, fig. 9.

Menopon tridens Nitzsch. Burmeister, Handbuch. d. Ent., 1832, vol. ii, p. 440; Giebel, Insecta Epizoa, 1874, p. 296, pl. xvii, fig. 9; Piaget, Les Pediculines, 1880, p. 479, pl. xxxix, fig. 1.

I have taken several specimens of a *Menopon* from Coots, Grebes, and Loons and from a single Tern, which are referable to this species, or at least to the group of forms of which *tridens* is the described representative. The descriptions of *tridens* by Piaget and by Giebel differ positively in various particulars, noticeably in the characters of the hairs. My specimens agree exactly with

neither of these descriptions, and besides differ among themselves in size and shape of head to such a degree that I have arranged them in three groups to which I give, tentatively, varietal rank. These varieties are as follows:

Var. *pacificum* Kellogg, from the Pacific Loon, *Urinator pacificus* (Bay of Monterey, California), and from five specimens out of ten of the American Coot, *Fulica americana*, shot near Monterey, California, and on two specimens out of five of the same bird species from Lawrence, Kansas; measurements, female, length 1.65 mm., width .62 mm.; head, length .28 mm., width .5 mm.; smaller than the succeeding variety which it otherwise resembles.

Var. *insolens* Kellogg (plate xv, figs. 3 and 4), from an Eared Grebe, *Colymbus nigricollis californicus* (Bay of Monterey, California), and from a Forster's Tern, *Sterna forsteri* (Lawrence, Kansas); measurements, female, length 2. mm., width .72 mm.; head, length .31 mm., width .53 mm.; markings distinct and dark; lateral bands of abdomen nearly black.

Var. *par* Kellogg, from a Western Grebe, *Aechmophorus occidentalis* (Lawrence, Kansas); measurements, female, length 2. mm., width .78 mm., head, length .31 mm., width .56 mm.; decidedly paler colors.

As already mentioned none of these varieties agrees with Piaget's or with Giebel's description of the species. The notable differences lie in the dimensions, in the presence through all of the varieties of six hairs on the occipital margin (Giebel says four; Piaget says two); and similarly through all the varieties the clear brown color of the lateral abdominal bands instead of an uncolored condition as affirmed by Piaget. The specimens of Piaget were taken from *Gallinula chloropus*; and his variety *major* based simply and certainly insufficiently on a dif-

ference in size amounting to but one-tenth of a millimeter in total length in the female and half that in the male, was taken on *Fulica atra*. Nitzsch found the species on *Fulica atra*, *Gallinula chloropus*, *Crex porzana*, *Podiceps auritus*, *Podiceps cristatus*; Denny found his *scopulacorne* on *Rallus aquaticus*, *Podiceps minor* and *Gallinula chloropus*. The species is easily recognized by the peculiar trilobed process, function unknown, on the under side of the hind-head (see fig. 4, pl. xv).

EXPLANATION OF PLATES.

PLATE II.—Fig. 1, Alimentary canal and salivary glands of *Menopon mesoleucum* (after Nitzsch). Fig. 2, Alimentary canal of *Docophorus fusicollis* (after Nitzsch). Fig. 3, Nervous system of *Lipeurus baculus*(?) (after Nitzsch). Fig. 4, Female genitalia of *Menopon mesoleucum* (after Nitzsch). Fig. 5, Male genitalia of *Menopon pallidum* (after Nitzsch). Fig. 6, Respiratory system of *Menopon titan* (original). Fig. 7, Head, under side, of *Læmobothrium* sp. (after Grosse). Fig. 8, Labium of *Tetraophthalmus chilensis* [= *Menopon titan*(?)] (after Grosse). Fig. 9, Labium of *Nirmus* sp. (after Grosse). Fig. 10, Antenna of *Tetraophthalmus chilensis* [= *Menopon titan*] (after Grosse). Fig. 11, Antenna of ♀ *Lipeurus*. Fig. 12, Antenna of ♂ *Lipeurus*. Fig. 13, Leg of ♂ *Tetraophthalmus chilensis* [= *Menopon titan*].

PLATE III.—Fig. 1, *Docophorus calvus* Kell., ♀. Fig. 2, *D. fuliginosus* Kell., ♂. Fig. 3, *D. graviceps* Kell., ♂. Fig. 4, *D. acutipectus* Kell., ♀. Fig. 5, *D. quadraticeps* Kell., ♀. Fig. 6, *D. montereyi* Kell., ♂. Fig. 7, *D. occidentalis* Kell., ♀. Fig. 8, *D. kansensis* Kell., ♀. Fig. 9, *D. atricolor* Kell., ♂.

PLATE IV.—Fig. 1, *Docophorus icterodes* N., ♀. Fig. 2, *D. pertusus* N., ♀. Fig. 3, *D. pertusus* N., juv. Fig. 4, *D. lari* Denny, ♀. Fig. 5, *D. insolitus* Kell., ♀. Fig. 6, *D. melanocephalus* Burm., ♀.

PLATE V.—Fig. 1, *Nirmus præstans* Kell., ♂. Fig. 2, *N. præstans* Kell., ventral aspect abdomen of ♂. Fig. 3, *N. hebes* Kell., ♀. Fig. 4, *N. farallonii* Kell., ♀. Fig. 5, *N. orarius* Kell., ♀(?). Fig. 6, *N. gigantica* Kell., ♂. Fig. 7, *N. bæphilus* Kell., ♀.

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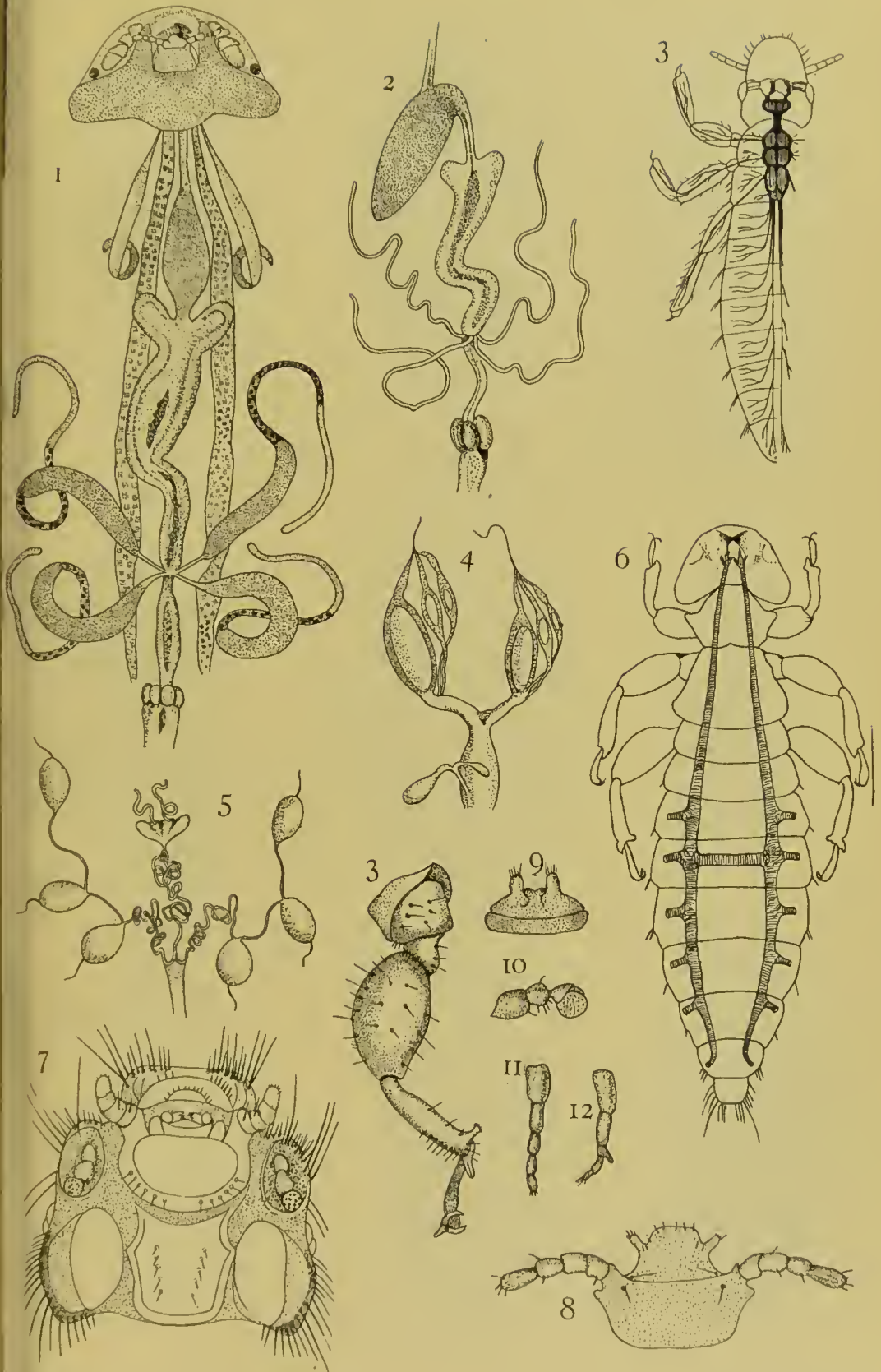
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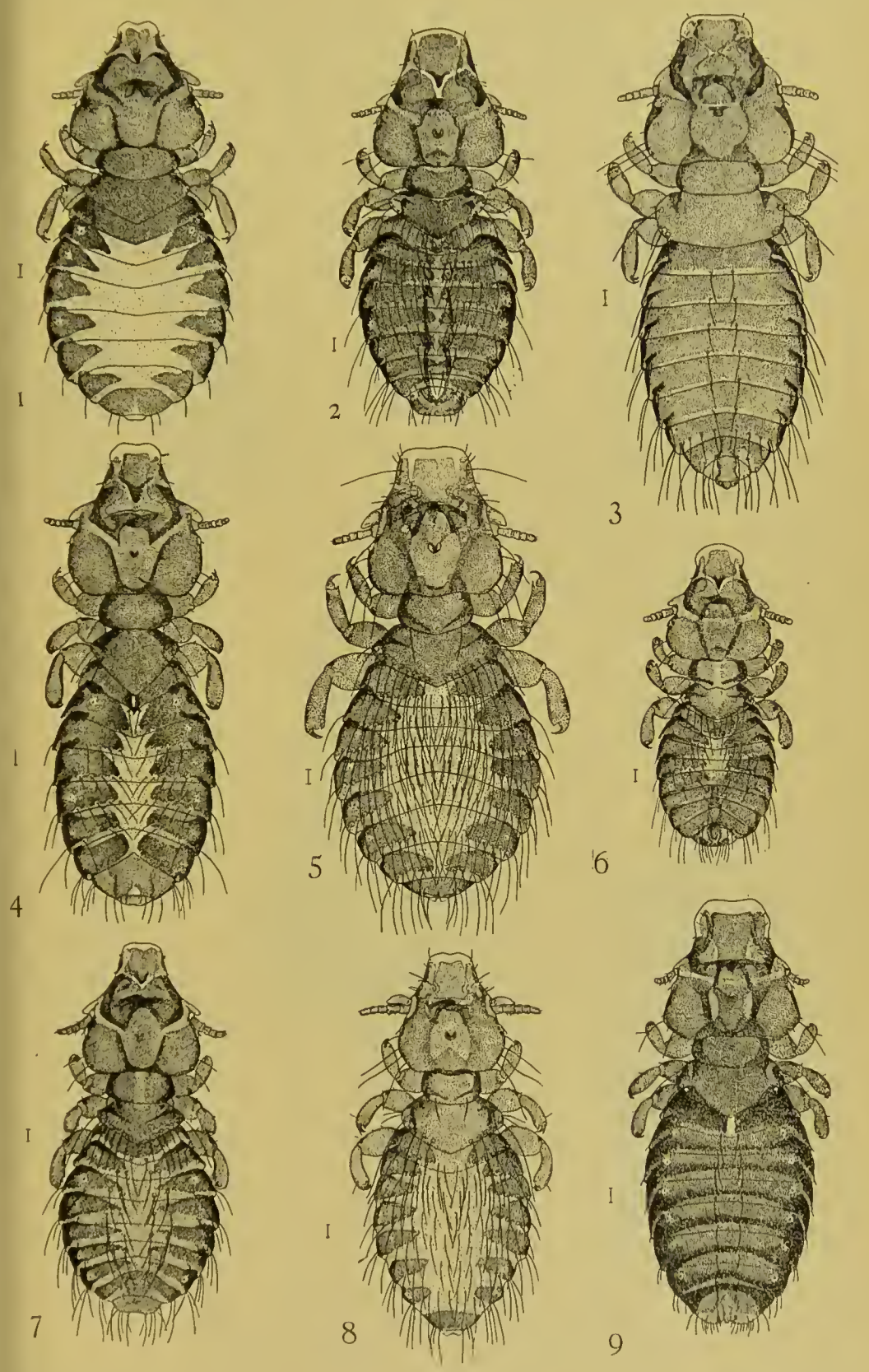
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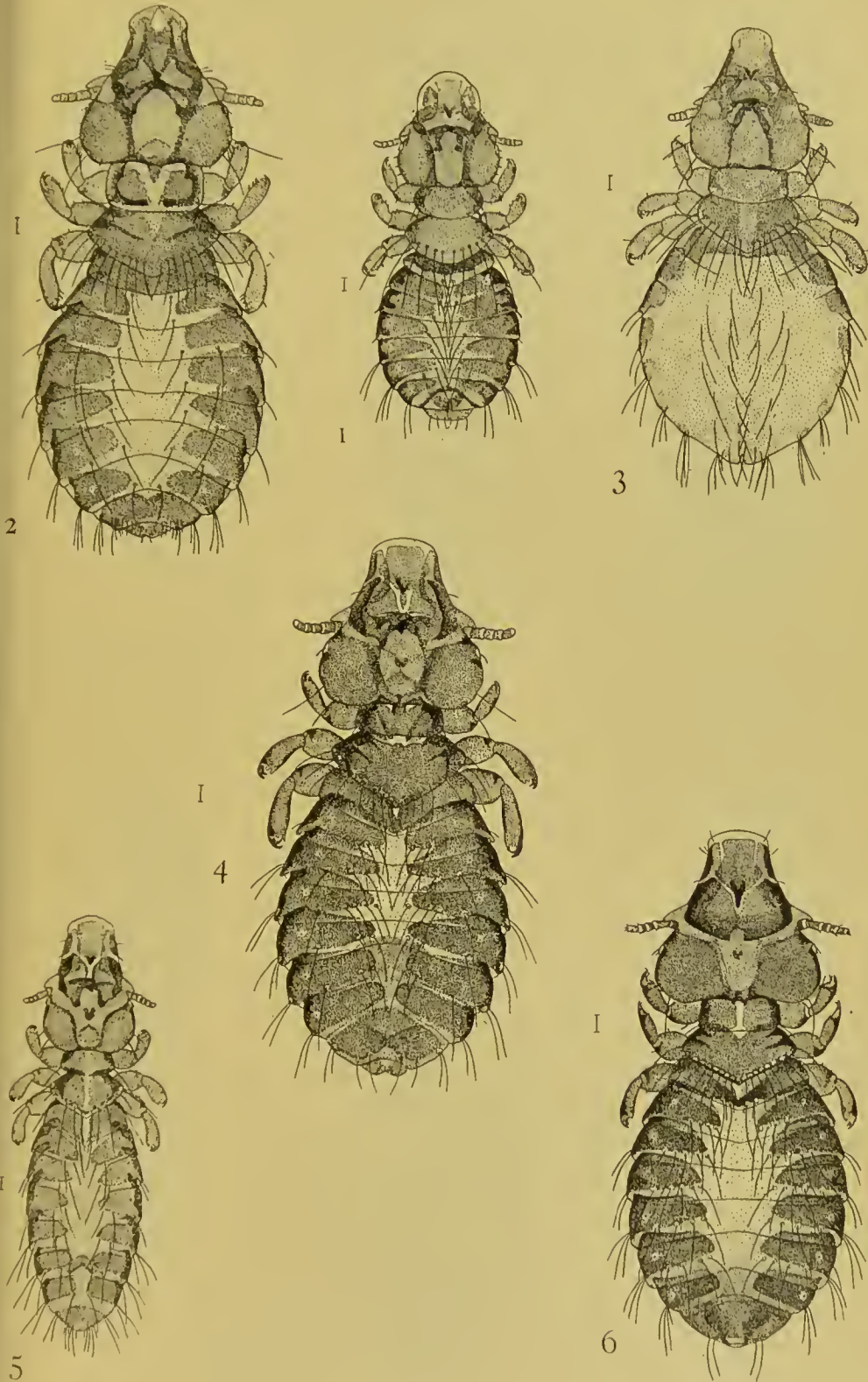
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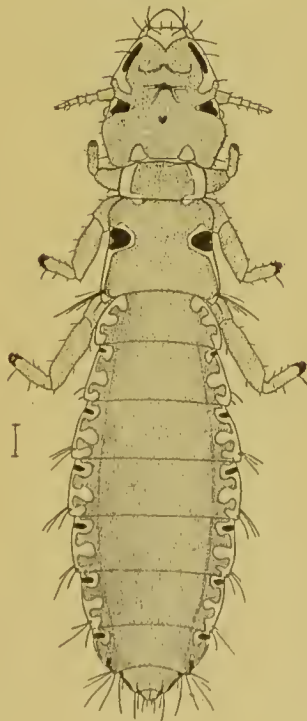
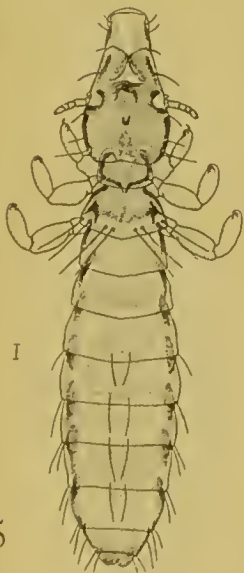
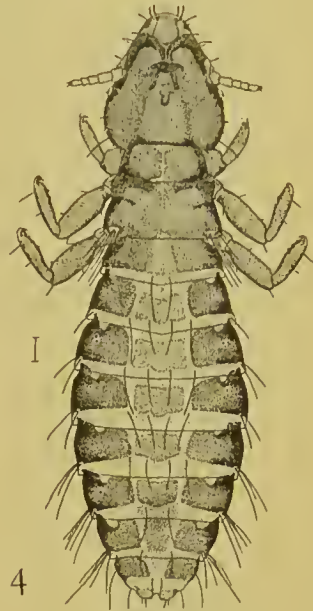
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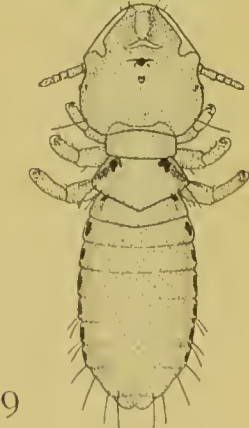
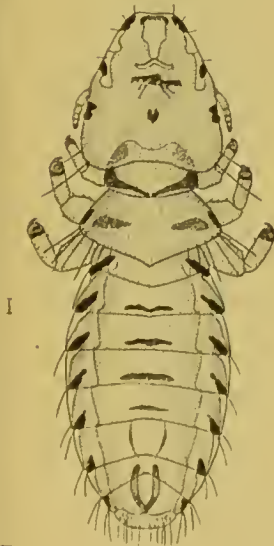
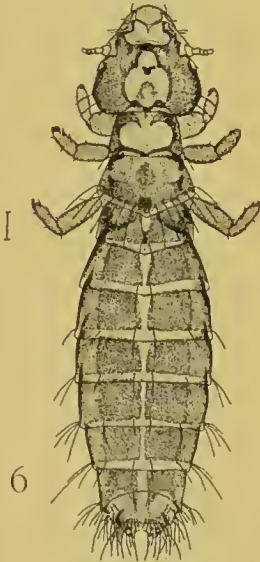
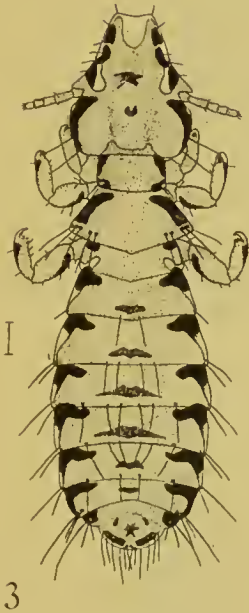
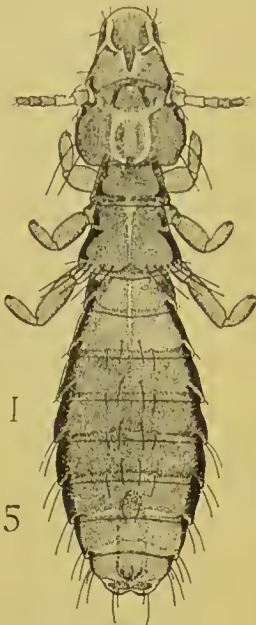
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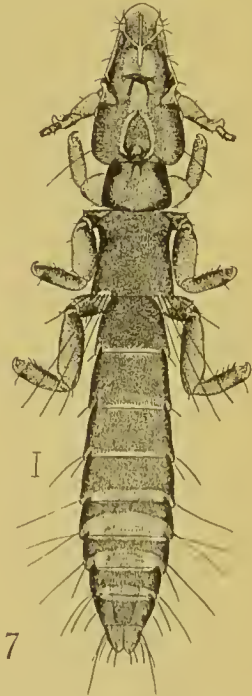
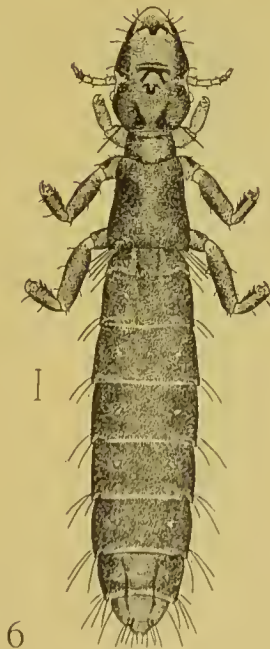
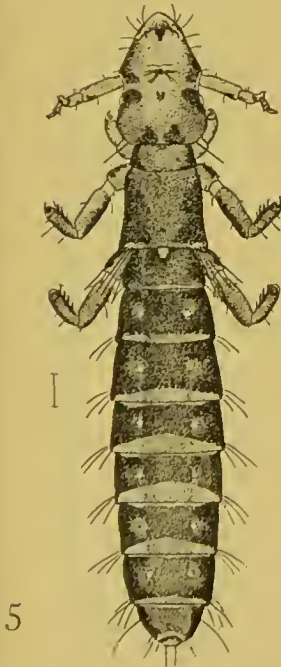
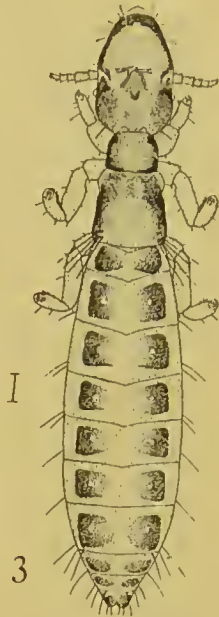
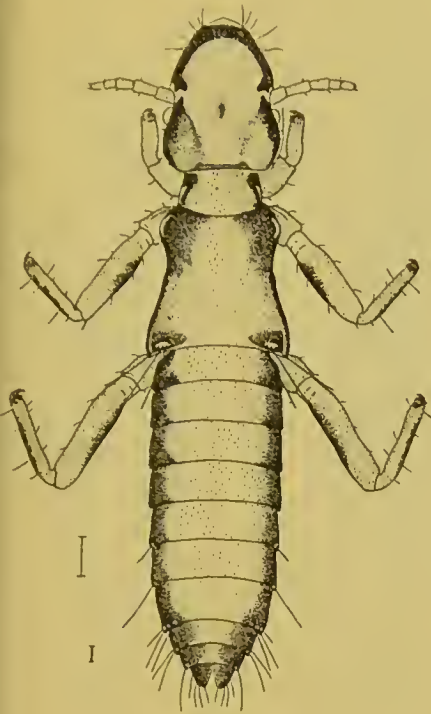


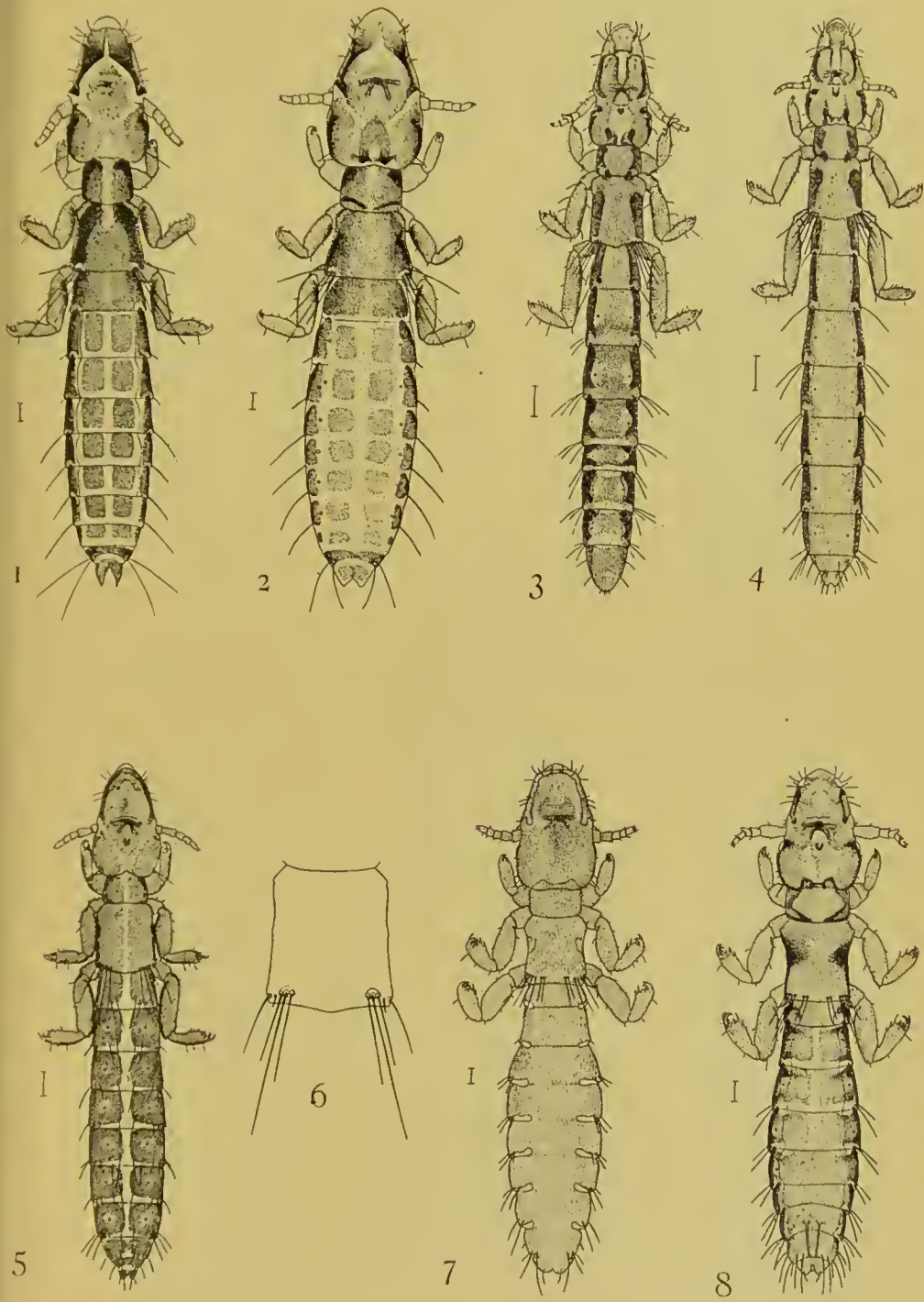


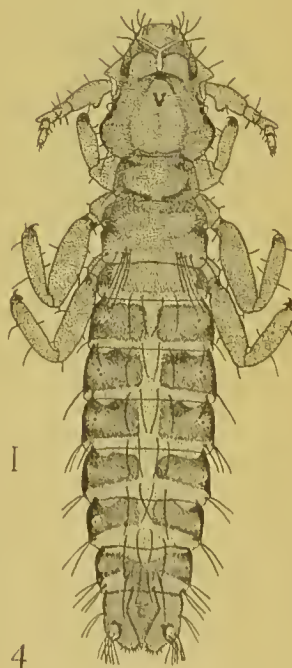
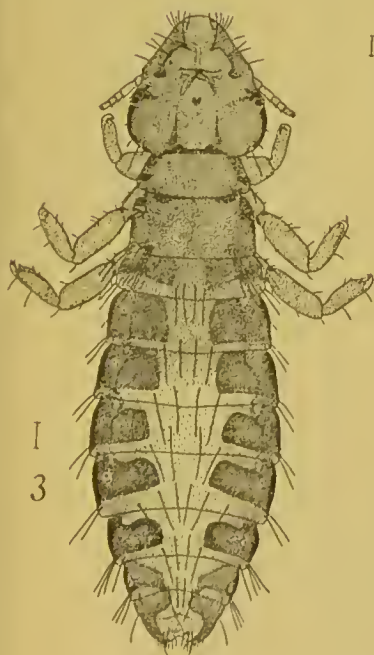
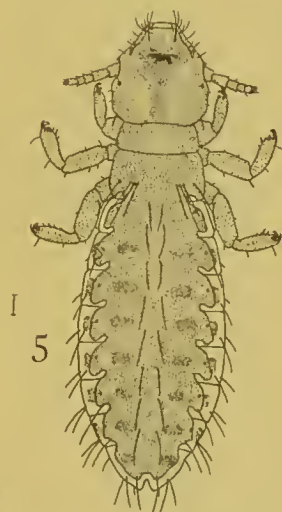
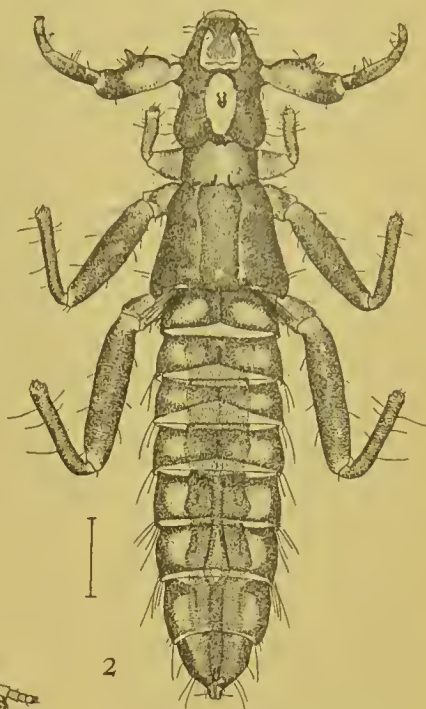
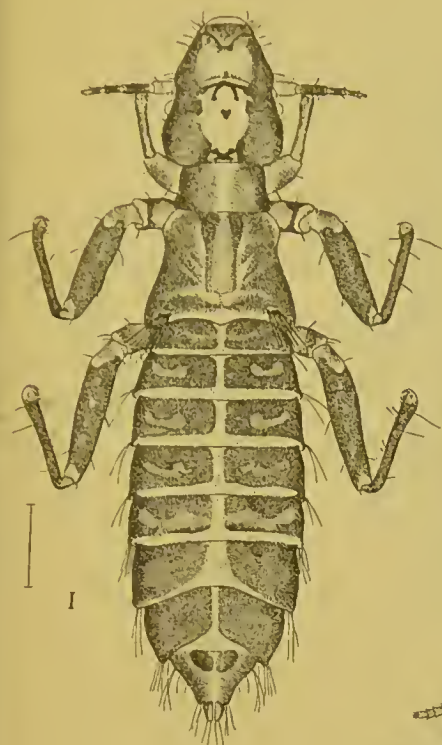


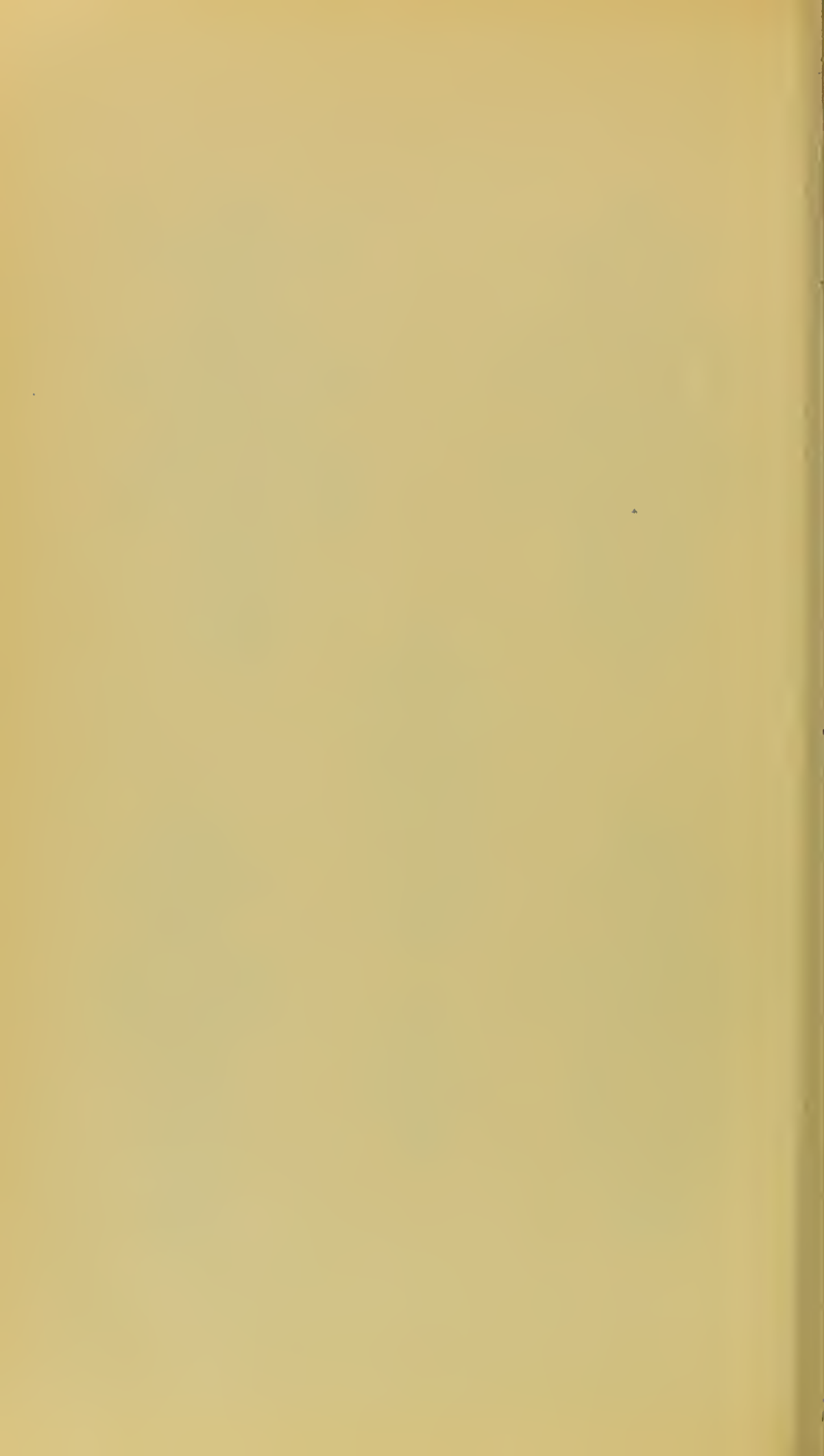


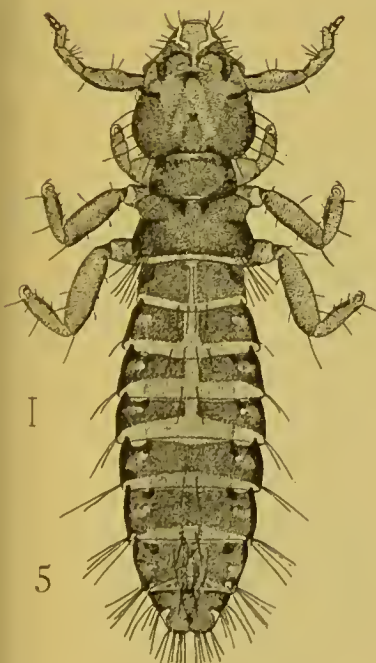
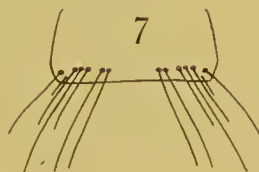
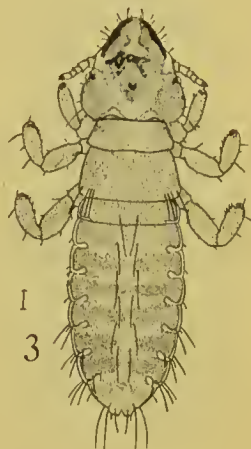
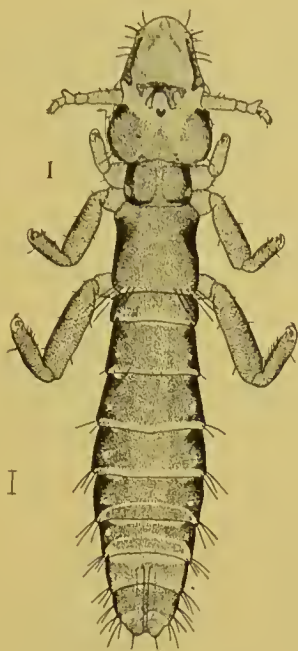


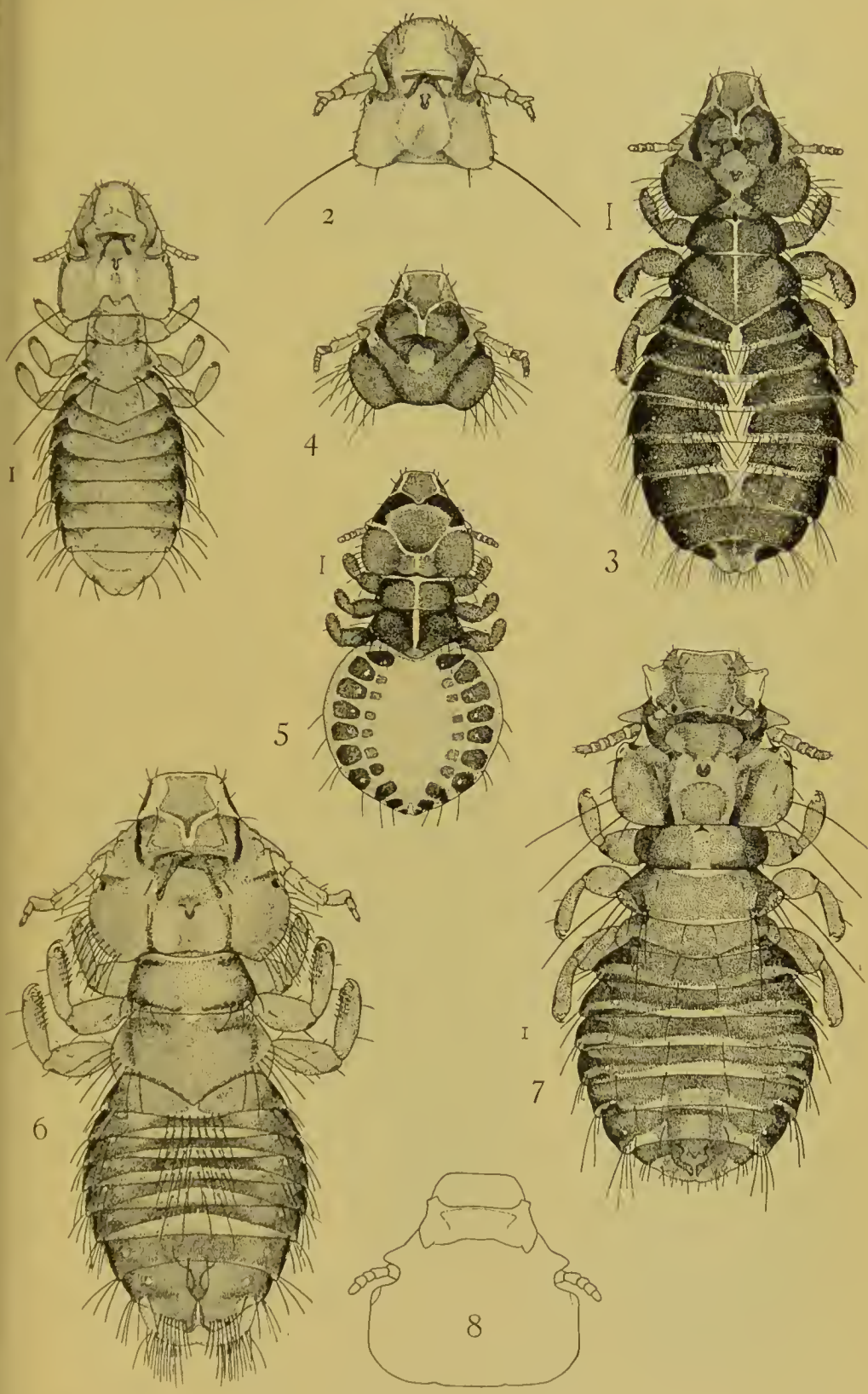


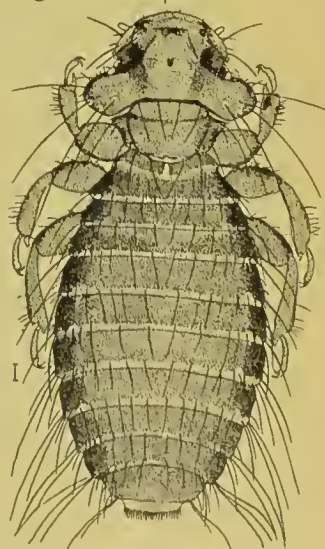
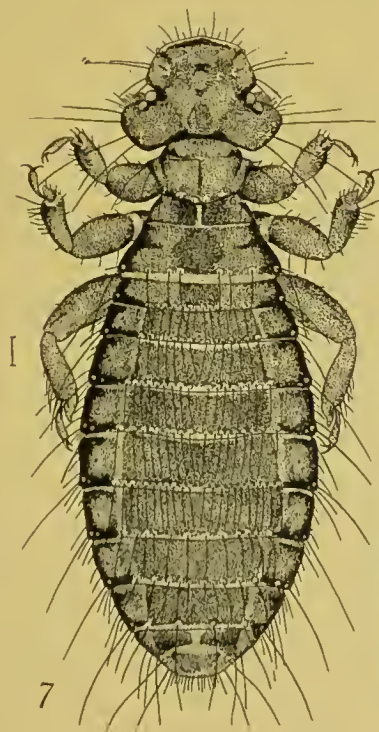
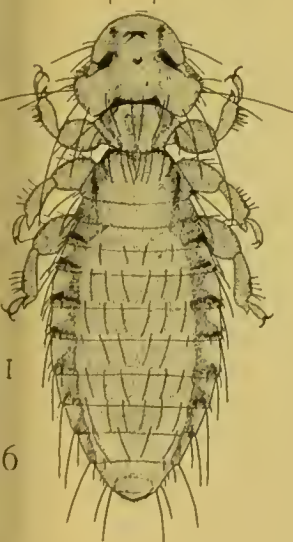
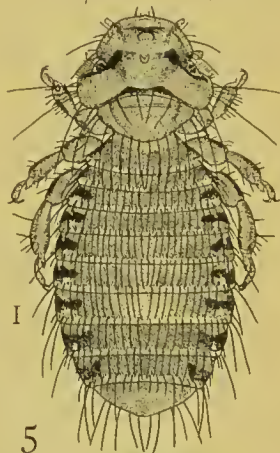
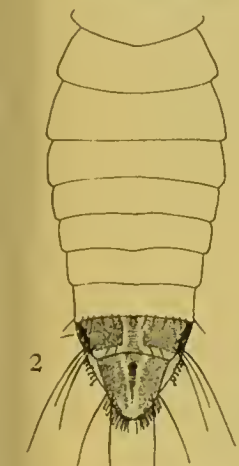
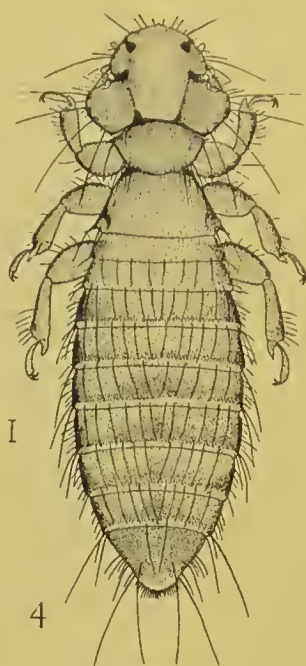
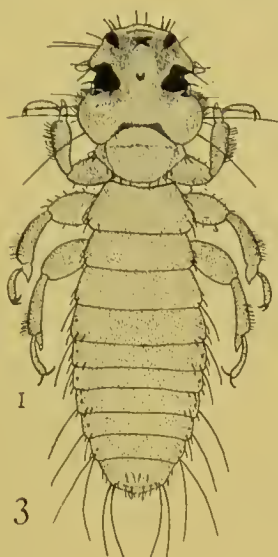
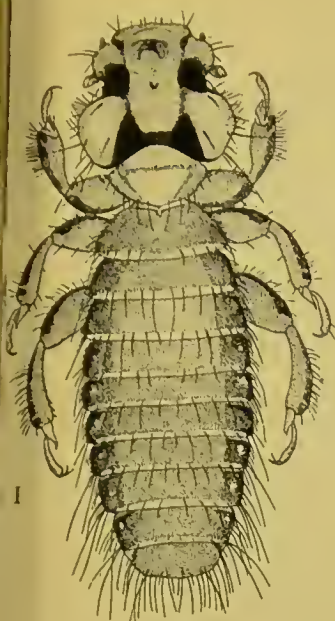


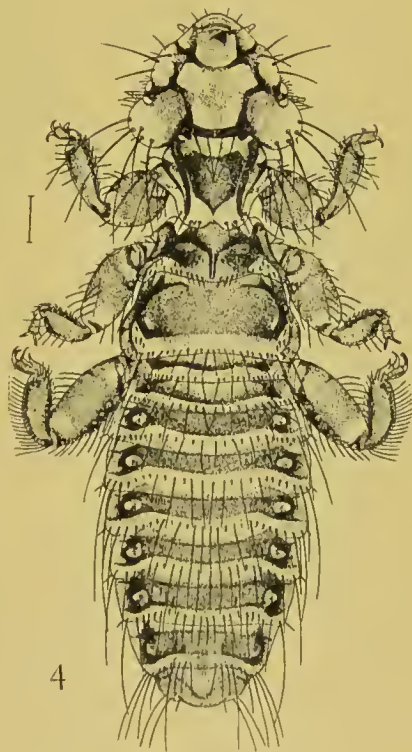
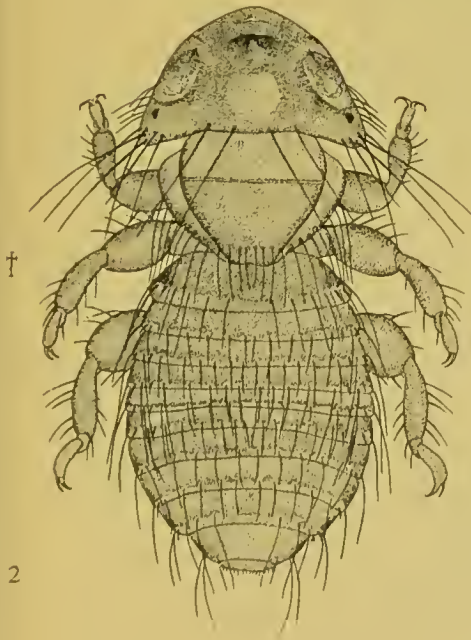
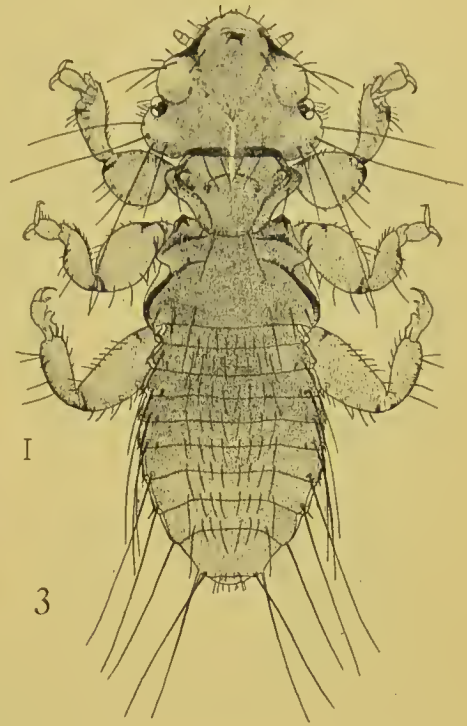
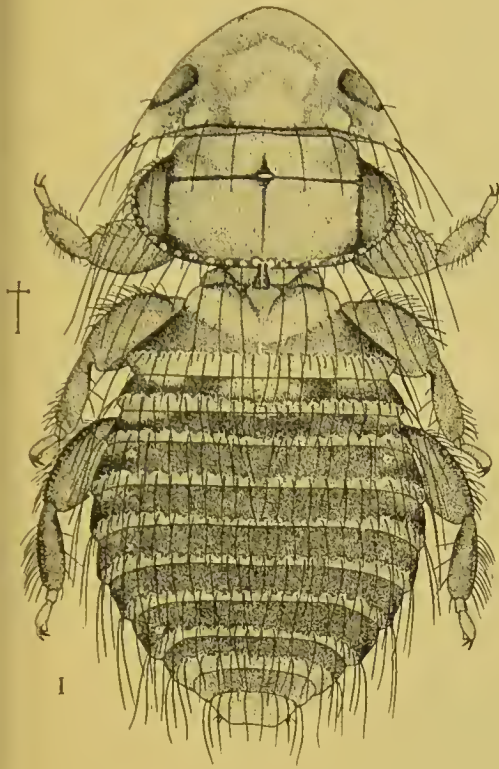


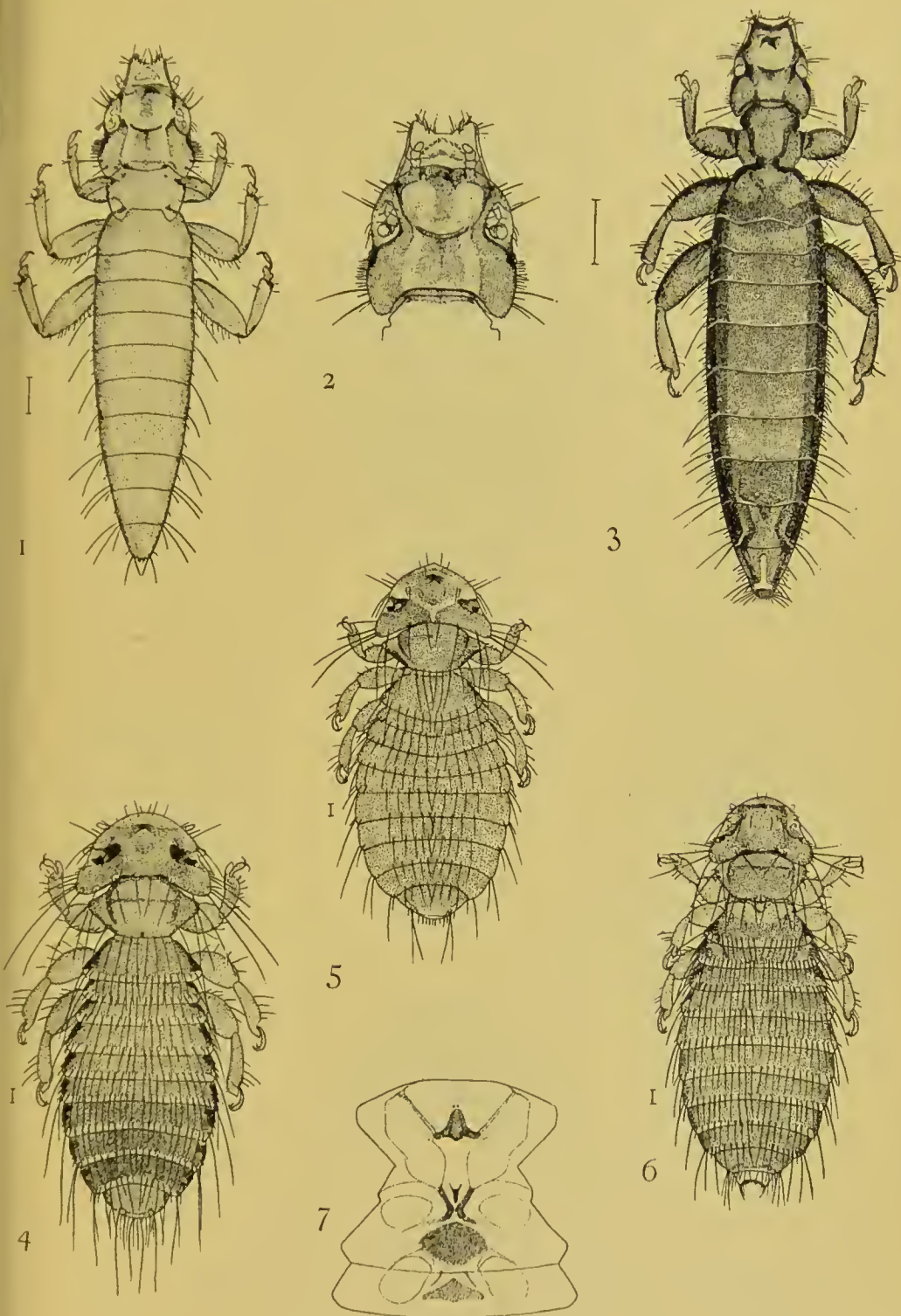


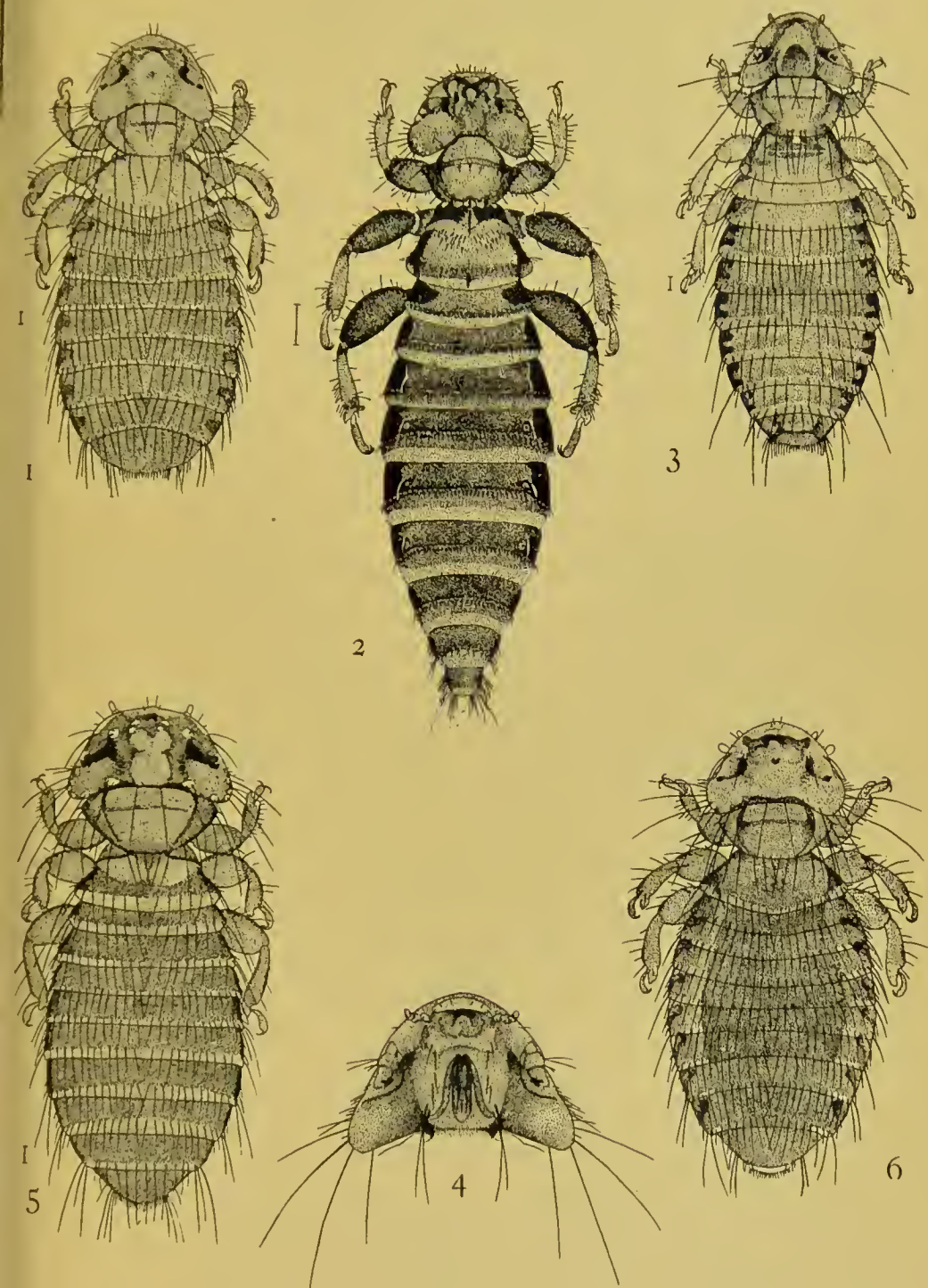












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VII

NEW MALLOPHAGA,

II,

FROM LAND BIRDS, TOGETHER WITH AN ACCOUNT
OF THE MALLOPHAGOUS MOUTH-PARTS.

BY

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(Reprint from the Proceedings of the California Academy of Sciences, Series 2, Vol. VI.)

LELAND STANFORD JR. UNIVERSITY,

PALO ALTO, CALIFORNIA,

1896.

PREFATORY NOTE.

This memoir is the seventh of a series designed to illustrate the investigations and explorations of the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University. The series is issued under the patronage of Timothy Hopkins, Esq., of Menlo Park, California. The present paper is published with the co-operation of the California Academy of Sciences, appearing simultaneously in its present form and as part of the Proceedings of the Academy.

CHARLES H. GILBERT,
OLIVER P. JENKINS,
Editors.

Date of publication, November 12, 1896.

AUTHOR'S PREFACE.

The following paper presents the descriptions and figures of thirty-three new species of Mallophaga, together with the identifications and figures of sixteen species previously described by European authors, but now, with few exceptions, first determined as parasites of American birds. All of these species have been collected, mostly by the author and Mr. R. E. Snodgrass, from land birds as opposed to water or shore birds. (As No. iv, 1896, of this series of "Contributions to Biology from the Hopkins Seaside Laboratory," under the title "New Mallophaga, I.," the author published the descriptions and figures of one new genus and thirty-eight new species of Mallophaga, with the identifications and figures of twenty-two previously described species, all from water and shore birds. In New Mallophaga, I, was given a "brief account of the structure, external and internal, of the life-history and habits, and of the zoological and geographical distribution of the parasites, together with a review of the literature of the group, and a statement of the present systematic treatment of the order, with a synopsis and tables of the families and genera"; the paper is intended to serve American students as an introduction to the study of the group.)

In the present paper there is also presented a somewhat detailed account of the mouth parts of several genera of Mallophaga, and an account of the mouth parts of the Psocidæ, Perlidæ, Termitidæ, groups which have been variously classed with or close to the Mallophaga, sufficiently full to make an intelligent comparison of the mouth structures of these various groups possible. Some

light seems to be thrown by this study on the phylogeny of the Mallophaga.

Types of the new species described will be placed in the collections of this University, in the collections of the California Academy of Sciences, and in those of the University of Kansas. The author has to express his obligations for services kindly rendered in connection with the preparation of this paper to Mr. F. J. Jack, artist, to Prof. Walter Miller, and to Mr. R. E. Snodgrass, who collected most of the specimens recorded from Californian birds, and whose careful work on the anatomy of the mouth parts is elsewhere more definitely referred to.

V. L. K.

STANFORD UNIVERSITY, September, 1896.

NEW MALLOPHAGA, II,—FROM LAND BIRDS; TOGETHER WITH AN ACCOUNT OF THE MALLOPHAGOUS MOUTH-PARTS.

(With Plates 1x-lxxiii.)

BY VERNON L. KELLOGG.

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THE MOUTH-PARTS OF THE MALLOPHAGA.

The mouth-parts of the Mallophaga are of the biting Orthoptero-Neuropterous type; that is, they are of that generalized kind of insectan mouth-parts in which there are free, strong, laterally working mandibles, free jaw-like maxillæ composed of distinct basal sclerites, articu-

lated terminal lobes and segmented palpi, and a labium composed of the fused second maxillæ with similar basal and terminal sclerites and segmented palpi. But the Mallophagous mouth-parts represent a modified, a specialized condition of this simple type, in which the reduction of the maxillæ with the complete loss of their palpi and (in one suborder) the loss of the labial palpi, so confuse, at first glance, the homologies of the various structures, as to make the proper understanding of the mouth-parts a matter requiring some special attention.

Nitzsch, the first student of the Mallophaga, misunderstood the structure of the mouth-parts, holding the labial palpi to be maxillary palpi (see figs. 1, 2 and 3, plate lx), and his error was not corrected until Grosse*, in his careful dissections of *Tetraophthalmus chilensis* [= *Menopon titan*], made the matter plain.

† Rudow gives a most confused account of the mouth parts, having evidently made very superficial observation, although he declares himself to have made a most careful and exhaustive study of them. He concluded, from observation of the hypopharynx, that the Mallophaga should be classed with the sucking insects, and particularly with the Hemiptera. ‡ Melnikoff thought the peculiar chitin structure in the pharynx (referred to later as the œsophageal sclerite) to be homologous with the sucking structures of the Pediculidæ, and therefore held the Mallophaga to be true sucking in-

* Grosse, Franz. Beiträge zur Kenntniss der Mallophagen. Zeitsch. f. wiss. Zool., vol. xlii, 530, p. pl. xviii, 1885.

† Rudow, Fred. Beobachtungen über Lebensweise u. Bau der Mallophagen o. Pelzfresser. Zeitschr. f. ges. Naturwiss., vol. xxxv, 1870, pp. 288-298.

‡ Melnikoff, N. Beiträge zur Embryonalentwicklung der Insekten. Archiv. f. Naturgesch., 1869, p. 136.

sects. * Denny, † Giebel, ‡ Piaget and § Taschenberg add nothing in their monographs to our knowledge of the mouth-parts. Giebel repeats Nitzsch's explanation of them; Piaget refers the palpi of the Liotheidæ to the maxillæ, and also says the labium of the Philopteridæ has 2-segmented palpi, referring doubtless to the paraglossæ; Taschenberg in his passing reference to the mouth-parts repeats Piaget's statements. || Grosse was the first to understand and to explain what seems really to be the true structure and homologies of the mouth-parts. He first indicated the labial character of the conspicuous palpi which are present in all of the Amblycera, called the labial palpar-like processes paraglossæ (see figs. 4 and 5, plate lx, *pg*), and gave some account of that sclerite in the œsophagus, which to my mind is so suggestive in its bearing on the phylogeny of the group. An abstract of Grosse's paper, by Prof. Geo. Macloskie, was published in the "American Naturalist," vol. xx, p. 340.

The following detailed accounts, with accompanying figures, of the mouth-parts of *Ancistrona gigas* P., *Læmobothirium* sp., *Eurymetopus taurus* N., and *Goniodes cervinicornis* G., are based on dissections made in my laboratory by Mr. R. E. Snodgrass, and are mostly in the words of his notes. The drawings also were made by Mr. Snodgrass.

* Denny, Henry. *Monographia Anoplurorum Britanniae*, 1842, London.

† Giebel, Christoph. *Insecta Epizoa*, 1874, Leipzig.

‡ Piaget, E. *Les Pédiculines*, 1880; Supplement, 1885, Leyden.

§ Taschenberg, O. *Die Mallophagen*, 1882, Halle.

|| Grosse, Franz. l. c.

THE MOUTH-PARTS OF *ANCISTRONA GIGAS*.

(Plate lx, figs. 6-12.)

In this form the full number of mouth-parts is present, and all are complete except the maxillæ, these lacking palpi and distinct sclerites. The labium is well developed and much longer than wide. It extends along nearly the whole length of the ventral surface of the head, the anterior border being situated far forward, leaving only the tips of the mandibles visible. When the palpi are parallel to the plane of the head their extremities project a little beyond the anterior lateral margin.

The *labium* (plate lx, fig. 7) consists of three distinct parts, the ligula, mentum and submentum together with prominent palpi. The mentum is the largest sclerite and bears the four-jointed palpi. It is somewhat wider than long, and is incompletely divided into three lobes, one placed medially and the others on each side of this. The median portion has the anterior border straight or a little concave, and articulates with the ligula. Each lateral lobe is narrow and projects anteriorly beyond the median portion which is much wider. Each bears distally a palpus. The latter is composed of four short joints of about equal length, but the second is rather thicker than the others. The lateral outlines of the mentum are roundly convex. The median lobe forms, in part, a concavity on the surface of the labium, but its posterior part forms a wide elevation, continues externally with the elevated lateral lobes, and is sharply marked off from the posterior part of the sunken portion. This elevated posterior border bears a pair of large, strongly chitinized, backward-projecting structures, each being a sort of fork, with two prongs articulated at their bases (plate lx, fig. 7, *pr.*). One of the prongs in each fork lies dorsal of and a little within the other. This

dorsal prong is attached by its base to the mentum near the hind margin of the latter. From the posterior border of the mentum a deeply emarginated fold extends backward between the two forks, and is attached to the inner edge of the dorsal prong of each. In the young the emargination is much less, the fold being merely roundly concave posteriorly. In this stage it is attached for its full length along the median line to the submentum. In each fork the dorsal prong is rather flattened dorsoventrally; its outer edge is rounded inward proximally and outward distally, while the inner edge presents the same outlines, only in different order, so that the whole is doubly bent, first inwardly and then outwardly. The curvatures, however, are only slight, and the distal one is more marked than the other. The prong is much wider at its base than elsewhere, and tapers off very much distally. It ends by a triangular expansion, having one side of the triangle facing posteriorly and inwardly. At the base is an oval fossa, and in this the outer prong is articulated so as to allow of considerable movement. At the anterior outer corner of each fossa a large strong hair arises and extends outward and backward, being two-thirds or three-fourths the length of the fork. The ventral prong is more cylindrical than the other and tapers but little. It is almost straight, or slightly curved inwardly near the middle. Its base, however, curves dorsally, to be articulated with the other piece, as just described. It ends by a bluntly rounded termination which is very slightly expanded. Its dorsal surface is covered by numerous fine, closely arranged, rounded ridges. Proximally these lie almost longitudinal, but they gradually become more transverse, so that the terminal ones form an angle of about thirty degrees with a transverse line through their inner ends. The ridges meet each other along the median

line of the prong at an increasing angle from in front backwards. The forks are less chitinized in young specimens, but very pale colored ones have them comparatively strongly chitinous, so that they appear very dark, while the rest of the outer parts are white.

The ligula is a short sclerite, divided into 'glossæ and paraglossæ. The glossæ are two rounded lobes, with a shallow concavity between them. They bear a few short hairs. External to the glossæ are the paraglossæ which are also two small simple lobes. They are separated from the glossæ a little more deeply than the latter are from each other, and like them are covered by a few small hairs.

The submentum is a simple sclerite back of the mentum, and mostly concealed by the forks and connecting fold from the latter.

The *maxillæ* (plate lx, fig. 8) are very weak, unchitinized structures, lying entirely within the mouth cavity, and concealed by the other mouth-parts on account of their very reduced size. Each consists of a basal undivided portion, somewhat roughly triangular in outline, and of two distal, soft fleshy lobes. The outer lobe is the larger of the two, and its inner edge lies ventral to the outer edge of the smaller lobe. Both lobes are longer than wide. There are no hooks or points of any nature, and no hard chitinous parts. The lobes appear to be galea and lacinia, but in the adult form there is nothing to show that these are what they are, and that they are not simply the result of a secondary division of a simple fleshy lobe, which is the common form of maxilla in the group. The basal portion shows no indication of being composed of two sclerites. The rudimentary condition and soft weak structure of the maxillæ apparently must render them of little or no function.

The *mandibles* (plate lx, figs. 6, 9 and 10) are large and strongly chitinized structures, and evidently perform an important part in the feeding habits of the insect. They are somewhat roughly triangular in profile, having each two points anteriorly and internally, opposing those of the mandible of the opposite side. They lie in a plane parallel to the head. The left one has its anterior surface smooth and a little convex. From the inner edge, a little back of the anterior angle, there projects inwardly and forward a short rounded process. Anterior to this and ventral to it the sharply terminated anterior angle of the mandible forms the second point or tooth. This one is very sharp compared with the other. The ventral surface is concave ventral to the posterior tooth and behind the anterior one. The latter is continuous down the ventral surface as a high wide ridge along the outer side. The posterior part of this surface is also elevated, and at the inner posterior angle is continued inward as a long and somewhat slender projection into the mouth cavity; this tapers distally, but terminates bluntly. At its base are two teeth projecting forward into the concavity on the ventral surface of the mandible just described.

The mandible is articulated to the head by a condyle and a facet. The condyle is on the posterior ventral edge, near, but some distance internal, to the outer posterior angle of the mandible. It is a rounded knot projecting backward. The facet is situated on the dorsal surface near the same angle of the mandible as the condyle. It, however, is not situated on the posterior edge, but somewhat further forward on the dorsal surface; but it lies in the same anteroposterior dorsoventral plane as the condyle. It faces posteriorly and outward, being situated on an elevation, and the cavity is rather shallow. The right mandible is a little smaller than the left but is

otherwise very similar to it. There are the same two teeth, but the posterior one is a little thicker than on the left side. The concavity on the ventral side is not so extensive, and the projection from the inner posterior angle is shorter and thicker. The articulatory condyle is similar in position, but is perhaps a little larger. The facet, however, is relatively more external. In each mandible there is a considerable extent beyond a line drawn from the condyle to the facet, but this is much shorter than that in the opposite direction; i. e., inwardly. Each mandible is supported by two large chitinous processes (plate lx, fig. 9, *d. ch. r.* and *v. ch. r.*), arising from a common thick base which is attached to both the ventral and the dorsal wall of the head. One of these processes lies ventral to the other, and, in the case of the right mandible, a little internal to it. The ventral projection bears terminally a socket and the dorsal one a condyle; these articulate respectively with the condyle and facet of the mandible. The mandible is thus supported on an axis above which is all its weight; and further, the greater part of the latter falls on the inner side of the axis when the mandibles are in the resting position. To the posterior edge of the mandible, near the inner angle but still some distance from it, is attached, movably, a slender chitinous rod. This rod passes posteriorly outward and dorsally, and is attached to the dorsal wall of the head by bundles of muscle-fibers. To the outermost projecting angle of the mandible are attached directly other but much smaller muscles. These have their insertion also on the wall of the head, back of the mandible. These various inequalities noticed on the two sides of the mandibular axes make the strength of the closure of the mandibles much greater than that of the opening.

There are several internal mouth structures rather cu-

rious in form, and whose functions are not definitely apparent, although they probably serve in some way for rasping or comminuting the food, or perhaps for holding it.

In the ventral wall of the pharynx is imbedded a chitinous rod or shaft, bearing two prongs at each end (plate lx, fig. 11, and fig. 6, *hy.*). The shaft is rather long and slender, with a swelling posterior to the middle. The posterior prongs are curved outward and backward, and also a little upward around the œsophagus. Their bases are very wide but they soon become narrower. Terminally each is somewhat expanded and ends bluntly. The anterior half of the wide basal portions is much thinner than the rest, and the shaft appears between the two as a wide elevated ridge, continuous with the posterior thickened borders. A large oval foramen, having its long axis extending from within outwardly and posteriorly, is situated between the thin part, the thickened shaft, and the posterior elevated margin. The anterior fork projects into the mouth, dorsal to the anterior end of the labium, in the position of a hypopharynx. The prongs of this bifurcation are much smaller than those of the other and project outward and forward. The entire length of the structure in a specimen measured is .52 mm. The part projecting is about a fifth of the whole. All but this latter part is imbedded in the ventral wall of the pharynx and is not visible from above. It is evident that it must be developed from an invaginated portion of the cuticle which became strongly chitinized and constricted off from that lining the mouth. The two anterior prongs have on their anterior edges each a padlike, soft, unchitinized structure. Each pad is distally surmounted on the dorsal surface by a large cluster of rather long, thick, curved processes, radiating from a common center and curving upwards.

All have their concave borders facing one another and the center from which they spring. Along the convex surface of each is a fringe of cilia inclined distally. The rest of the pad is covered by short, thick projections, lying with their long axes parallel to the surface and curving over to the dorsal side, where they become scale-like in form. Between this hypopharynx and the labium is a fold of membrane from which project the anterior ends of two other structures. There are two chitinous rods (plate lx, figs. 6, *fk*, and 12) whose anterior forked ends project through this fold and lie beneath and a little external to the hypopharynx. They may be exposed by removing the labium. Each lies ventral to all the other organs in the head. Posteriorly they diverge from each other and pass backward, ventral to the lower edge of the tentorium, and are attached to the ventral wall of the head by muscles. They are very slender and delicate on account of their thinness and being not very strongly chitinized. Anteriorly each is rather expanded and flattened dorsoventrally, but posteriorly becomes narrower and more cylindrical. The outer prong of the anterior bifurcation is wide and thin, the other is longer, narrower, a little curved outwardly, and rather more chitinous than any other part of the whole rod. The bifid part projects out of the fold as described, but very little if any of the shaft. The cuticle covering the fold is continuous with that over the pads on the fork of the hypopharynx, and is covered by small sharp-pointed papillæ, having enlarged bases, and projecting forward.

THE MOUTH-PARTS OF *LÆMOBOTHRIUM* SP.

(Plate lxi, figs. 1-5.)

The *labium* of *Læmobothrium* sp. (plate lxi, figs. 1 and 4) consists of submentum, mentum, palpi, and ligula. The labium as a whole occupies two-thirds of the length of the ventral surface of the head. Its anterior border lies in front of the bases of the antennæ, and extends also considerably farther forward than the bases of the mandibles; hence the latter are almost concealed by the labium.

The submentum (plate lxi, fig. 4, *sm.*) is a transversely narrowed sclerite very convexly rounded posteriorly, and slightly concavely rounded laterally where it joins the temporal sclerites. The anterior border is more decidedly concave and articulates with the convex posterior border of the mentum. The submentum is a little wider than half its length, and on the whole is somewhat narrowly shield-shaped. In front of the submentum is the mentum (plate lxi, fig. 4, *m.*). This sclerite is wider than long and is somewhat oval in outline, with the long axis transverse; the latter is a little in front of the middle point. The lateral and posterior borders are very convex, and the sclerite may also be regarded as being an isosceles triangle with the angles very much rounded, and the apex pointing backward. Laterally there are two short thick, anterior prolongations, *pf*, one on each side. These bear the short four-jointed labial palpi. Each segment of the palpus is rather short and cylindrical and bears a few hairs. The terminal one is shorter than the others and forms a rounded termination to the palpus. The ventral surface of the mentum is produced downward into a large saccular or pouchlike distention which is almost as wide and long through its greatest diameters as

the mentum itself. Where the pouch joins the mentum, however, it is narrower than it is a short distance below; it therefore expands a little ventral to its dorsal border. In a mounted specimen the pouch may be pressed down flat against the rest of the labium, and then its anterior border appears to be a fold of membrane extending over the ventral surface of the ligula from the anterior edge of the mentum. Within this pouch are two large glands (plate lxi, fig. 5) lying side by side, one on each side of the median line. They are narrower anteriorly where they open into the mouth cavity near the anterior edge of the labium. Posteriorly they become enlarged and turn outward.

The ligula is composed of glossæ and paraglossæ. The glossæ are flattened lobes, one on each side of the middle line, and separated from each other for about two-thirds their length. Each is about as wide as long, and the anterior border slopes slightly outward from within. The outer borders are straight. The paraglossæ lie just exterior to the glossæ. Each is conical with the end truncated, and is a little longer than the glossæ.

The *maxillæ* (plate lxi, figs. 1, *mx*, and 3) are simple lobes expanded distally but narrow at the base. Each projects inwardly and forward, and lies just back of the mandibles of the same side. The ends are exposed in front of the labium. The length is much greater than the greatest width, and the borders are all convex except the posterior two-thirds of the outer, which is a little concave. The anterior and inner edges form a continuous curve, and along these borders the maxilla is strengthened by a chitinous thickening. Along the anterior margin and the anterior part of the inner, is a series of chitinous teeth which are not very sharp and have their points mostly directed inwardly. Each is a continuation of a plication, or thickening, on the maxilla outside the chitinous mar-

ginal thickening and perpendicular to it, the latter lying close to the edge, just back of the teeth. Near the base of the maxilla on the inner side is attached a large muscle, as large as the maxilla itself. This large muscle and the strong teeth seem to indicate that the maxilla is not functionless, but that it plays some part in the mastication of the food.

The *mandibles* (plate lxi, fig. 2) are the same in general shape and position as those of *Ancistrona gigas*. Those of the two forms present corresponding processes, and in each they lie in a plane parallel with the head. They are in both triangular in general outline viewed dorsoventrally.

The right mandible of *Læmobothrium* has at its anterior inner corner a large, strongly chitinized tooth, which is a continuation inward and forward from the ventral surface of a strong anterior thickening of the mandible. Posterior to this is a second tooth, just as in *Ancistrona*, continuous with the dorsal surface. This, however, instead of being regularly rounded is in *Læmobothrium* very wide, especially at the base, and is of the form of a truncated cone. The inner, or free end, is roughened by several short blunt cusps. This tooth, however, very evidently is the same thing as the posterior tooth of *Ancistrona*; the positions on the mandibles are identical.

From the inner posterior angle is a thick blunted process extending inward. It is rather short and terminally rounded. This process is present also in *Ancistrona gigas*. The outer posterior angle is truncated, and at its inner corner, projecting from the ventral surface, is an articulating condyle. This is some distance from the outer corner, and to the latter is attached the extensor muscle. The condyle projects backward and a little outward, and fits into a socket of the head. Dorsal to this on the head

is a condyle which articulates with a facet on the dorsal side of the mandible. This facet is more external than the condyle of the mandible, and is also farther forward. In all these points the mandible is extremely similar to the corresponding one of *Ancistronea*. The retractor muscle is attached directly near the inner posterior angle.

The left mandible is in general similar to the right, and agrees with the corresponding mandible of *Ancistronea* in the same way as the right one does, although the two are rather less alike than those of *Ancistronea gigas*.

The posterior tooth of the left mandible is continuous from the dorsal surface, but is very small compared with the anterior one, and is sharp-pointed compared with the corresponding tooth on the right side. The anterior tooth is much the same as that on the right side, or is perhaps a little smaller. Back of it is a depression on the inner part of the ventral surface; this is bounded behind by an elevation which is continuous inwardly as a slender projection from the ventral surface, just as in the case of *Ancistronea gigas*. This process is thick at its base but tapers distally to the rounded termination. Its anterior border is convex, but on the distal half of the posterior margin is a rather deep, rounded concavity. To the outer angle of the base is attached the extensor muscle. This is rather large on each side of the head. Internal to the attachment of the extensor muscle is the articulating condyle, and dorsal to the latter the rather large facet. These articulate as on the other side, with a facet and condyle, respectively, of the ventral aspect of the head.

THE MOUTH-PARTS OF EURYMETOPUS TAURUS.

(Plate lxii, figs. 1-8.)

There are many striking differences between the mouth-parts of this form and those of either *Ancistrana* or *Læmobothrium*. The dissimilarity is most noticeable in the labiums. *Ancistrana* and *Læmobothrium* both belong to the suborder Amblycera, while *Eurymetopus* and the next form to be described, *Goniodes*, belong to the suborder Ischnocera, and the differences presented by these four genera are typical for the two groups.

In *Eurymetopus taurus* the *labium* (plate lxii, figs. 1 and 6) is reduced in size, and very much crowded back on the posterior aspect of the head. Instead of covering over the mandibles ventrally, it leaves them entirely exposed, its anterior border reaching only about as far forward as their posterior articulations.

On the posterior half of the median ventral surface of the head is a large unchitinized space. This is bounded laterally by the temples, posteriorly by a narrow, gular sclerite, presenting an obtusely angulated, convex, anterior border, and anteriorly in appearance by the mandibles, although it is really not bounded at all in front. The area is somewhat heart-shaped, having the apex forward, for the boundaries formed by the temples are convergent forward.

The membranous labium stretches across the posterior half of this space, while the part in front of the labium forms the mouth-opening. The labium is composed of the full number of sclerites, and of these the submentum is the largest. It is much wider than long; is unchitinized and membranous, and is attached all around, except in front, to the edges of the space just described. Its lateral edges are convex and rounded, while the posterior border is angularly emarginated to receive the convex

margin of the gula. Its posterior angles are much rounded. Anteriorly it presents a concave border of which the lateral portions are free, but the median part bears the mentum. The submentum, on account of its anterior and posterior concavities, is much constricted in the middle.

The mentum is a comparatively narrow, transversely elongated, unchitinized sclerite, attached posteriorly to the submentum, but having its lateral borders free. The anterior outer angles are rounded. The median portion of the anterior border bears the glossæ and paraglossæ. These are not separated by any suture from the mentum, and hence there is no distinct ligular sclerite. The glossæ are two small oval lobes situated on each side of the median line and close to each other, being only slightly separated. Each bears four or five large, strong hairs situated on small basal segments. External to each glossa is a rather deep fossa in the mentum. In these fossæ are situated the paraglossæ. These are cylindrical structures having the outer ends somewhat enlarged, and bearing six or seven large, strong, two-jointed hairs like those on the glossæ. The paraglossæ are rather strongly chitinized compared with the rest of the labium; they appear dark while the other parts are white. Each is directed outward, forward, and downward. With the exception of the hairs on the glossæ and paraglossæ there are almost none on the labium. Two small ones situated on basal joints occur on the mentum, one just back of each glossa. The oddly shaped, cylindrical paraglossæ, having the stiff, thick, two-jointed hairs on the flattened outer ends, are very characteristic of the suborder Ischnocera. In undetached labiums there often appears to be a narrow sclerite between the sclerites which have been called mentum and submentum, but in the mounted specimen this does not appear.

The *maxillæ* (plate lxii, fig. 4) are simple, fleshy, unchitinized lobes attached to the lateral parts of the mouth-cavity, back of the mandibles. They show no indication of division into different sclerites. Near their bases they are somewhat thickened; the distal ends are weak and almost membranous, in mounted specimens they generally appear twisted and distorted. On account of the position of the labium the maxillæ are mostly exposed, only the bases being concealed. Each projects forward and inward.

The *mandibles* (plate lxii, figs 1 and 5) present a very strange appearance, both on account of their shape and their position. They are large, heavy, and strongly chitinized, and very remarkably different from those of *Ancistronea* and *Læmobothrium* in the way they are attached to the head. In these two genera the mandibles lie in a plane parallel to the head, and move in this plane. In order that this may be so, their articulating surfaces are in the same or nearly the same dorso-ventral line. In *Eurymetopus taurus* there are two articulating surfaces as before, but the mandibles move in a plane which forms a large angle with the horizontal plane of the head. To accommodate this action the articulating surfaces lie one in front of the other. The plane of the mandible is, however, not at right angles to that of the head, and consequently the anterior articulation is a little dorsal to the posterior one. In the next form to be described, *Goniodes cervinicornis*, the mandibles are almost or quite at right angles to the head, thus presenting an advance in this respect beyond *Eurymetopus*. In either of these two genera the mandibles may be regarded as being the same, typically, as in the Amblycera; but that each has been revolved on an axis passing from the tip of the inner basal process to the articulating condyle,

until the anterior margin becomes the ventral margin. All the apparent differences may be reconciled by this view. In accordance with it the articulating surfaces lie as they should. Further, the mandibles being as in the other genera, two-toothed, the posterior rounded tooth of *Ancistrona*, arising from the inner dorsal margin, lies in this form on the anterior inner aspect, in front of, and dorsal to the larger tooth.

The left mandible has also the long slender process at the inner part of the base, as in *Ancistrona* and *Læmobothrium*; but, as would be expected, this arises from the dorsal aspect of the base. Since, however, in *Eurymetopus* it is very long and slender, it is bent backwards so as to lie parallel with the head. In *Goniodes cervinicornis*, however, it is shorter and projects inwardly.

The mandibles of *Eurymetopus taurus* are entirely exposed on the ventral surface of the head, not even their bases being covered by the labium. They are thick and have a clumsy appearance. The anterior articulating surface is a large facet situated at the anterior outer angle of the mandibles, on the dorsal surface. A rounded process projects over it from below. The posterior outer part of the mandible, bearing the condyle by which it is articulated posteriorly, is greatly prolonged backward, forming a long process bearing the condyle at the extremity. The latter fits into a chitinous socket on the ventral surface of the head. Some distance in front of this is a condyle which fits into the facet of the mandible. The process above referred to, arising from the inner dorsal aspect of the left mandible, curves inwardly and posteriorly. It is very wide at its base but rapidly diminishes distally, and ends by a slightly enlarged extremity, free in the mouth cavity. The ventral tooth of each mandible is large and thick, and bluntly pointed. The dorsal

tooth is shorter than the other, not so thick, and has a rounded termination. Its anterior border is just visible from the ventral side of the head, in front of that of the ventral tooth.

In *Eurymetopus* and in a large number of other genera of the Mallophaga there occurs a very curious pharyngeal sclerite with accessory structures, within the cavity of the head. It is not intended here to explain the origin or function of these, but merely to describe them.

The sclerite referred to is a thick, strongly chitinous structure situated in the ventral wall of the pharynx, and is probably a greatly modified portion of its chitinous cuticle. In a mounted specimen it is plainly visible through the head from either the upper or the lower side. Lying ventral to the sclerite are two structures which appear to be glands, and are connected with it by a duct. All three of these structures are visible through the head of cleared and mounted specimens, and lie just back of the anterior edge of the labium.

This *oesophageal sclerite* (plate lxii, figs. 1, 2, 3 and 7) is in general form cup-shaped, having the hollow part turned upward and forming a depression in the floor of the pharynx, since its interior is simply a part of the pharyngeal cavity. The ventral surface is very convex, being almost hemispherical. The anterior end is truncated, but from each of the two anterior angles thus formed there projects forward, outward, and dorsally, a large dorso-ventro-laterally flattened process, which lies in the lateral wall of the pharynx, the two partly surrounding the cavity of the latter. Each of these processes is expanded distally, and sends a long, rounded, and bluntly terminated projection backwards. These latter processes lie parallel with and a little external to the lateral margins of the body of the sclerite, their outer edges being visible from

the ventral side. Posteriorly there is a thick, rounded, median process which projects backward from near the dorsal edge of the sclerite, but still some distance below it, so that it is free from and not imbedded within the wall of the pharynx.

The sclerite, viewed ventrally, is somewhat shield-shaped in profile. The body is almost semicircular, with a small segment taken off in front by the anterior truncation referred to. Posteriorly there projects the median rounded process, and anteriorly on each side the anterior lateral processes. The latter give to the anterior profile an emarginated appearance. In the middle there is a longitudinal light colored area, due to the cavity on the dorsal side, the floor of which, being thinner than the other parts, transmits more light in mounted specimens. This area is expanded near the front, contracted from side to side posteriorly, and rounded before and behind. Along the median line there is a narrow linear area, still lighter in color, due to a groove in the bottom of the dorsal hollow.

The dorsal surface of the sclerite is, as already described, excavated, and is doubly so, there being one cavity situated within another. The upper of these is a shallow depression, having its edges rather oval in outline. In front it extends very near the anterior borders of the sclerite, but on the sides the edges of the cavity and those of the sclerite are considerably separated; and that portion of the dorsal surface between these two is rounded outwardly and ventrally. This space is narrowed again posteriorly, but not so much as in front. The inner cavity is situated in the floor of the other. It is much deeper, and its walls are steep, meeting the interrupted walls of the other at a considerable angle. It is this deeper cavity that forms the light colored area

noticeable on the sclerite when viewed from the ventral side by means of transmitted light. It is much longer than broad, and its widest diameter is in front of the middle. Anterior to this the dorsal edges form a rounded outline, but back of it they are a little concave and approach each other posteriorly. The posterior end is narrow and rounded. The walls of the cavity are concave, steeper in front and behind than elsewhere. The bottom slopes a little downward posteriorly, so that the cavity is deepest behind. Running longitudinally along the bottom is a narrow groove; this begins in front at the bottom of the anterior wall, and extends backwards from an aperture which is the opening of a duct into the sclerite.

To the sides of the shallower cavity are attached two large, laterally compressed, chitinous, pyramidal structures, one on each side, whose ventral surfaces are not quite so divergent as the walls of the cavity to which they are attached, or perhaps better, from which they arise. The bases of these are very wide, but dorsally they become rapidly narrowed and pass upwards around the œsophagus, or pharynx, as two chitinous bands. Their dorsal ends are attached by large muscles to the dorsal wall of the head.

The sclerite is about as wide as long, or sometimes a little longer. The dimensions of one specimen measured are as follows: Length of the body, .097 mm.; width, .108 mm.; length of posterior projections, .02 mm.; distance which anterior processes extend in front of anterior border of the main part or body, .0227 mm.

The gland-like structures (plate lxii, figs. 1, 7 and 8) before referred to, lie ventral to the sclerite, and the inner halves overlap its outer portions (fig. 7). Their outer edges also lie a little dorsal to their inner edges, so that they ex-

tend slightly around the outer margins of the sclerite. Each is an oval structure, having the long diameter extending from within outwards and backwards. The ventral surface is convex, and the dorsal surface concave, while the whole is very much flattened dorsoventrally. Each is invested in a thin chitinous envelope, and is seated upon the ventral anterior surface of a chitinous pedicle which is expanded where it receives the gland. The expanded portion of the pedicle is thin and convex ventrally, so as to fit the dorsal concavity of the gland; and the middle of its shallow dorsal concavity lies below and external to the outer edge of the sclerite. Back of the glands the pedicle extends backward and outward, but not so much in the latter direction as the long axis of the gland, so that the two form an obtuse angle inwardly. The part of the pedicle not having the gland attached is about as long as the other part, and it is somewhat more chitinous. It tapers backward, but ends in a foot-shaped expansion, with the toe turned outward. To this is attached a large, wide muscle which extends backward to its origin in the posterior part of the head cavity. At the posterior end of the gland, on the ventral surface, a duct arises which passes forward, attached closely to the gland, to its anterior end; here it leaves the gland and continues forward, but soon turns inwardly and dorsally, and then posteriorly, meeting and fusing with the duct from the gland of the other side. This common duct then runs backward to the sclerite, which it enters as already described. The relative positions of the glands and sclerite vary somewhat, since they are evidently movable structures, judging from the attached muscles, and hence, also, the duct varies in position; but all such changes are slight. The free portion of the duct consists of an inner chitinous tube continuous with that

soldered to the glands, but in addition to this there is an outer portion composed of a series of closely set, chitinous rings, surrounding the tube. Each gland is about as wide as the sclerite, but is considerably longer.

THE MOUTH-PARTS OF GONIODES CERVINICORNIS.

(Plate lxi, figs. 6-9.)

In *Goniodes cervinicornis* as in *Eurymetopus taurus* the mouth-parts are crowded far back on the ventral surface of the head, so that the bases of the mandibles lie posterior to the bases of the antennæ, instead of in front of them, as in most of the Amblycera.

The *labium* (plate lxi, fig. 7) has its anterior border between the bases of the antennæ, and hence it is very much shortened from before, back. The part which seems to have suffered most in the crowding is the mentum. It is narrow and not distinctly separated from the ligula, and is farther aborted by having lost its palpi. This condition is true not only in the genera *Eurymetopus* and *Goniodes*, but holds for the Ischnocera generally.

The main sclerite of the labium is the submentum. This is a large unchitinized sclerite, having a straight posterior border and a very concave anterior border. The sides present an obtusely angulated, convex margin. The anterior border is so deeply and roundly concave that it forms almost a semicircle. Its most posterior part is as far back as the middle of the lateral edge of the sclerite; hence there is a narrow portion projecting forward on each side. These reach as far anteriorly as a line joining the middle of the bases of the antennæ. The rest of the labium is situated in the concavity of the anterior part of the submentum. It consists of the fused mentum and ligula (plate lxi, fig. 7), and is divided into three lobes, two lateral and one median. The median lobe is almost

square, and has its anterior border slightly emarginated and the anterior outer angles projecting a little. This lobe is thus composed of the glossæ, which are separated only by the anterior emargination. The lateral lobes are rounded and bear the cylindrical paraglossæ. These are almost identical with the paraglossæ of *Eurymetopus*, being also more strongly chitinized than the rest of the labium, and bearing on their slightly expanded ends a few strong hairs with basal segments. They project ventrally and a little inward and forward, the distal ends being nearly always seen first on focussing down on a specimen toward the ventral surface.

Back of the submentum is a narrow gular sclerite continuous across the median line from the lateral portions of the head.

The *maxillæ* (plate lxi, fig. 6) are soft unchitinized structures lying within the mouth cavity. Each is divided into three lobes: one basal, another terminal, and the other between these two. By the basal lobe the maxilla is attached to the wall of the head, and it projects inward into the mouth cavity. It is irregularly round in outline and is entirely unchitinized. The middle lobe is of about the same size as the first, and is joined to the latter by a constricted neck. This lobe projects forward and inward within the cavity of the mouth. The third lobe is the largest and is oval in profile, with the long axis at right angles to that of the middle lobe, to which it is attached by a narrow neck at its inner and posterior aspect. This lobe, as well as the middle one, is entirely unchitinized. It projects out of the mouth cavity, and lies close behind the mandible of the same side.

The *mandibles* (plate lxi, figs. 8 and 9) are large and strong; their bases lie some distance back of those of the antennæ; they hang downward from the head in a

plane almost perpendicular to it, but inclined very slightly forward; their tips meet in the middle line, so that they form an arch over or ventral to the mouth-opening. The anterior lateral projections of the submentum extend forward beyond the bases of the mandibles, and the glossæ and paraglossæ lie just back of their posterior margins. Hence the mentum, ligula and mandibles are all enclosed in the anterior semicircular border of the submentum.

The right mandible is triangular in dorsoventral section. The ventral part is thickened and prolonged inwardly at the inner ventral angle, forming two large thick, bluntly pointed teeth. These are separated from each other only by a slight emargination, and they lie one anterior to the other. The anterior of these probably corresponds with the dorsal tooth of the mandible of *Ancistriona gigas*; if so, it has changed its position so that its tip is as far forward as that of the posterior tooth, and these two have become fused into a single process. The anterior tooth, however, does not reach quite as far inwardly as the posterior one, and is also a little dorsal to it. Both of these positions correspond with those of the dorsal tooth of *Ancistriona gigas* and *Læmobothrium*. A large thick process projects inwardly from the inner dorsal angle. This very evidently corresponds with the extremely similar process from the posterior inner angle of the right mandible of *Ancistriona*, and with the less similar but certainly homologous process of *Læmobothrium*. This projection is the inner end of a posterior thickening of the mandible which bears near the outer angle of the base, on the posterior aspect, the articulating condyle. This projects dorsally, and fits into a socket on the ventral side of the head. On the anterior side of the mandible, somewhat more ventral than the condyle, is the articulating facet into which fits a condyle from the ventral surface

of the head. The facet presents the peculiarity of having no inner wall, and is separated only by a constriction from a large cavity in the anterior thickened part of the mandible. This cavity is elongated in a line extending from the facet to the two teeth of the mandible. The posterior wall of the cavity is very thin.

Attached to the dorsal border of the inner angle of the mandible is a large thin chitinous plate (plate lxi, fig. 9, *ch. pls.*). This plate is thickened proximally and appears here darker than the rest. This part is also narrow, but distally the plate expands and becomes very thin and transparent. The distal border is not definite, being very thin and generally irregularly broken away. Attached to this plate are the retractor muscles of the mandible. The plate and muscles extend dorsally and very slightly backward from the mandible, since they lie in the same plane as the latter. From the outer posterior angle of the mandible there extends dorsally and outward a slender, very thin, chitinous structure, which bears the extensor muscles of the mandible. These two sets of muscles are attached to the dorsal wall of the head. The left mandible is very similar to the right. The two teeth are more separated and are sharper. The process projecting inwardly from the base is slenderer and longer than on the right mandible. It arises a little ventral to the dorsal inner angle, and is slightly rounded ventrally, while the tip is again turned a little in the same direction. The muscles are attached in the same way as in the case of the right mandible. To the dorsal inner border of each mandible there is attached, also, internal to the attachment of the plate, a fringe of large muscle fibers; these appear to be a second set of retractor muscles.

In *Goniodes cervinicornis* there is a pharyngeal sclerite and pair of glands which are in every way similar to those

of *Eurymetopus taurus*. Besides these, however, there are two forked rods projecting into the mouth cavity, as in the case of *Ancistrona gigas*. These rods are extremely slender and difficult to dissect, but they lie just dorsal to the labium, and pass forward beneath the oesophagus, and ventral to the glands connected with the pharyngeal sclerite. Only the bifid tips project into the mouth. Near the anterior end muscle fibres are inserted which pass forward and downward to their origin on the dorsal side of the labium. These evidently serve to draw the rods forward. Those of *Ancistrona gigas*, which is enormous amongst Mallophaga, are almost invisible to the naked eye, being weakly chitinized, and only .5 mm. long by .05 broad at the widest place. Only one specimen of the species of *Læmobothrium* described was had for dissection, and the rods may have been present but overlooked. Also it cannot be stated that they do not occur in *Eurymetopus taurus*. It is to be noticed that the genera *Ancistrona* and *Goniodes* belong to the two different subgroups of the Mallophaga.

RESUMÉ.

From these detailed accounts of the mouth-parts of four genera of Mallophaga, equally divided between the two principal groups of the order, we may confidently make a summary statement of the condition of the mouth structures of the Mallophaga.

The mouth-parts are confined to the ventral aspect of the much flattened head, the frontal margin of the head being formed by the greatly developed clypeus. The labrum is the foremost of these ventrally located mouth structures, and is well developed, serving for prehension, and in some cases as a disk or platelike sucker for attach-

ment. It appears as a simple flap lying in front of, and, when at rest, partly over the mandibles.

The *mandibles* are large and strong, usually roughly triangular in profile, with at least one projecting sharp-pointed tooth, and one or two blunter teeth. Each mandible presents a characteristic facet and a condyle which articulate with two strong chitinous rami attached one to the ventral wall of the head and one to the dorsal wall. One ramus articulates by a condyle with the facet of the mandible, and the other by a facet with the condyle of the mandible. The mandibular muscles are exceptionally large. In the two genera of the suborder Amblycera, the mandibles lie in a plane parallel to the horizontal plane of the head, while in the two genera of the suborder Ischnocera, the mandibles project in a plane nearly or quite at right angles with the horizontal plane of the head. This remarkable difference is probably characteristic of the two main groups of the order. The mandibles, though varying somewhat in shape in the two groups, are essentially similar in general character and in manner of articulation; the articulations in the Amblycera lie in a dorso-ventral line, while in the Ischnocera they lie in a cephalo-caudal line; if, however, the Amblycerous mandibles be assumed to be rotated through 90° , so that the anterior aspect becomes directed ventrally, all of the apparent differences in position of features and manner of articulation between the mandibles of the two suborders become reconciled.

The *maxillæ* are greatly reduced, the basal and terminal sclerites so fused as to make it almost impossible to differentiate them, and the structure so feebly chitinized as to appear usually as a soft, small membranous lobe, lying almost wholly concealed within the mouth cavity. The inner border is sometimes chitinized, especially dis

tally, and bears few to many small teeth. Sometimes the distal part of the maxilla is two-parted and these two parts may represent the galea and lacinia of the typical maxilla of the orthopterous type. The maxillary palpi are completely lost, there being no indication of them on any of the maxillæ examined.

The *labium* (see, in addition to figures previously referred to, plate lxiii, figs. 1, 2, 3, 5, and 6) shows some considerable variation in the two suborders. In the Amblycera it is a larger and more complete structure than in the Ischnocera. A distinct submentum, mentum, and ligula are always present, the ligula consisting of the two terminal lobes, glossa, and paraglossa of each constituent half of the labium, united at their bases. With the Amblycera conspicuous 4-segmented palpi rising from a basal segment-like palpifer are always present; while with the Ischnocera palpi are wanting. The ventral or other surface of the labium is in some forms (see *Ancistronea gigas*) provided with strong backward-projecting, pointed, sometimes bipartite processes, as with *Ancistronea gigas*, *Menopon tridens*, *Menopon robustum*, and others. These processes must subserve some holding on or clasping function.

A hypopharynx of elaborate structure was observed in *Ancistronea gigas*, but not in the other species dissected. Grosse refers to a delicate membranous fold of the ventral wall of the mouth, which in some forms projects beyond the ligula as the hypopharynx.

The "forks" observed in *Ancistronea* and in *Goniodes*—genera representing both suborders of Mallophaga—because of their similarity to the familiar "forks" of the Psocidæ are of exceptional interest, and have not heretofore been referred to in the literature of the Mallophagous mouth-parts. Most plainly discernible in *Ancistronea*,

they are very small, fine, chitinous rods lying inside of the mouth above the labium, whose posterior ends are attached to the ventral wall of the head by muscles and whose anterior ends are shortly forked or bifurcated, and project through the lining of the ventral wall of the mouth, thus lying free and uncovered in the mouth cavity. Although not observed in the other two genera of Mallophaga dissected, it is not at all certain that they are not present, their extreme minuteness and delicacy making their discovery a matter of difficulty.

The œsophageal sclerite and glands are also structures of extreme interest from their probable identity with similar structures in the Psocidæ. They do not appear to be present in all the Mallophagous genera; but I have observed them in a majority of the genera, viz., *Docophorus*, *Nirmus*, *Lipeurus*, *Eurymetopus*, *Goniodes*, *Goniocotes*, *Gicbelia*, *Oncophorus*, *Trichodectes*, *Colpoccephalum*, and *Menopon*; also in Piaget's figures of *Akidoproctus* the sclerite is indicated. I have found the sclerite and glands absent in *Aucistrana*, *Nitzschia*, *Trinoton*, *Læmobothrium*, and *Physostomum*. It will be noted that the sclerite and glands are present in all Ischnocera examined, and in two of the Amblycerous genera; while in a number of other Amblycerous genera the structures are wanting. In *Læmobothrium*, where the sclerite is wanting, there is a pair of glands in the labium, evidently quite distinct from the œsophageal glands so far referred to. This œsophageal sclerite is a thickening of the chitinous intima of the pharynx, and appears as a bonnet-shaped sclerite lying on the ventral wall of the pharynx, with hollow part upward, with median groove closed behind, projecting processes at the anterior angles, and a pair of long slender "bonnet string" pieces, which project dorsally and pass on either side of the pharynx, or œsophagus, upward and

around it, and attach by their ends to the dorsal wall of the head. Opening into the median groove from its ventral side is a small duct, which, followed to its source, is seen to come from the union of a pair of ducts, each one of which comes from an oval gland lying ventral to the sclerite, and fitting into a concavity on the anterior end of a weakly chitinized, pedicle-like structure, which projects backward and is attached by a foot-shaped expansion to a large, strong muscle. This sclerite, which I call the "œsophageal sclerite," shows distinctly through the dorsal and ventral walls of the head, so that it is usually a conspicuous feature in the markings of the head, appearing as a V- or U-shaped mark with thickened sides (see this mark in the various figures illustrating the systematic part of this paper). It is this sclerite which has been called in the monographs of the European writers the labium, and in my "New Mallophaga, I," I have constantly referred to it by the same name. It is this sclerite, too, undoubtedly, which is the subject of Melnikoff's references, in his embryological memoir, to a sucking apparatus. Grosse refers to this sclerite as the Schlundskelett, and describes it, briefly, in *Tetraophthalmus chilensis* (= *Menopon titan*) and *Goniodes dissimilis*. He found also a chitin thickening of the dorsal wall of the pharynx, immediately above the ventral sclerite.

The mouth-parts of the Mallophaga are distinctly fitted for biting; there are no mouth structures which lend any probability to the old theory that the Mallophaga took food by sucking. The peculiar pharyngeal structures, while not yet understood in point of function, are not at all of a character to suggest anything like a sucking function. Grosse comes to no definite conclusion regarding the function of these œsophageal sclerites, but he says: "Ich schliesse aus seinem Bau, dass derselbe nicht zum Saugen,

sondern zur Ergreifung und zur Führung der aufgenommenen Federtheilchen dient." All of my observation, as far as it goes, tends to substantiate the belief, based on the structure of the mouth-parts, that the Mallophaga take all their food by biting. I have seen them biting off and eating the bits of feathers, and the crop content, which shows plainly through the skin of many specimens, is always composed of tiny bits of feathers.

COMPARISON WITH THE MOUTH-PARTS OF ALLIED INSECTS.

It should be of interest now to compare the mouth-parts of Mallophaga with the mouth-parts of those insects which have been placed in recent classifications nearest to the Mallophaga. Since the breaking down of Erichson's catch-all order, Pseudo-Neuroptera, the association of the Mallophaga, Termitidæ, Perlidæ, Embidæ, and Psocidæ, into the order Platyptera has been, until very recently, the usually accepted interpretation of the place of the Mallophaga among insects. The most recent classifications assign to the Perlids, Termites and Mallophaga ordinal rank. Undoubtedly the Mallophaga are to find their affinities among the members of the group Platyptera, and it is, therefore, with the mouth-parts of these insects that I shall attempt to compare the Mallophagous mouth-parts.

THE MOUTH-PARTS OF THE TERMITIDÆ AND THE PERLIDÆ.

(Plate lxiv, figs. 1-4.)

The Termitidæ (White Ants) present a racial or generalized condition of the simple Orthoptero-Neuropterous type of biting mouth-parts; free, strong, toothed mandibles, working meso-laterally; maxillæ (plate lxiv, fig. 2)

well developed, with distinct cardo, stipes, palpifer, 4-segmented palpus, and both terminal lobes, the lacinia sharply two-pointed, and the outer hoodlike galea fleshy; labium (plate lxiv, fig. 1) with elongate elliptical submentum, mentum, 3-segmented palpi, and ligula showing in each half both glossa and paraglossa. The Termite species whose mouth-parts I figure to illustrate the general character of the Termite mouth structures is *Termopsis angusticollis*, a large form common in California.

The Perlidæ, as the Termitidæ, present the generalized biting type. In the adult Perlids, to be sure, the mouth-parts seem to be hardly functional, being reduced to a semimembranous condition, with some correlated changes in form. In the nymphs, however, the usual Orthopterous form is shown. I have figured the mouth structures of a nymph of *Perla* (plate lxiv, figs. 3 and 4). The mandibles of the adult are very small and but slightly chitinized.

THE MOUTH-PARTS OF THE PSOCIDÆ.

(Plate lxiv, figs. 5-11.)

The mouth-parts of the Psocidæ present a modified or specialized type of biting mouth-parts. They have been the subject of some study and some dispute, and perhaps are not yet fully understood. An especially confusing feature is the presence of the "forks," and characteristic and little understood organs are the paired "lingual glands" lying "within the tongue." The best paper on the Psocid mouth-parts is one by Edward Burgess,* in which special attention is given the forks and the lingual glands.

* Burgess, Edward. The Anatomy of the Head, and the Structure of the Maxillæ in the Psocidæ. Proc. Bost. Soc. Nat. Hist., 1878, vol. xix, p. 291, pl. viii.

In the two subfamilies of the Psocidæ, the winged Psocinæ and the degraded, wingless Atropinæ, the attitude of the head varies from a hanging or vertical position in the Psocinæ to the nearly horizontal position of *Atropos*. With the change from vertical to horizontal position there goes a marked flattening of the head, so that the head of *Atropos* (plate lxiv, figs. 5 and 7) in its horizontally projected attitude, its flattened condition, and the limiting of the mouth-parts to the ventral aspect of the head, shows both in its relation to the body of the insect and in its own shape and condition, a great similarity to the horizontal, flattened head of the Mallophaga. The clypeus of *Atropos* is large, projecting far forward, and, as in the Mallophaga, forms the frontal margin of the head, the labrum lying on the ventral aspect of the head (plate lxiv, fig. 5). All the mouth-parts lie on the ventral aspect of the head (plate lxiv, fig. 5). The mandibles (plate lxiv, figs. 5, 6, and 8) are strong, toothed, and present distinct protruding condyles wholly similar in position and general character to those of the Mallophaga (see plates lx-lxiii). The maxillæ (plate lxiv, fig. 5) I do not understand, but there are no conspicuous terminal free lobes; there is a large basal part, and articulating with it the conspicuous 4-segmented palpi. The fork is long and slender, projecting farther forward than the front margins of the closed mandibles. The labium (plate lxiv, fig. 5) shows a large elongate submentum, a hexagonal mentum, and a ligula composed of two large, free outer lobes, and a median bilobed part composed of the inner lobes of the two sides partly coalesced. According to Burgess what I have called outer lobes are the reduced 1-segmented palpi. In addition the œsophageal sclerite (described hereafter for *Psocus* under the name "œsophageal bone") shows through the basal part of the labium.

Burgess has studied the mouth-parts of *Psocus* in detail, and for the sake of his accounts of the forks, and of the œsophageal sclerite and lingual glands, those structures so characteristic of the Psocidæ, and probably—certainly, in the case of œsophageal sclerite and lingual glands—quite as characteristic of the Mallophaga, I quote from his paper referred to, as follows:—

“The maxilla in *Psocus* is hinged to the head by a small obscure piece which is immovably soldered to a larger joint. The first piece represents, probably, the cardo of a typical maxilla (plate lxiv, fig. 10, *c*) and the second the stipes (*p*). The stipes bears outwardly the 4-jointed maxillary palpus, while inwardly is hinged a thick, fleshy lobe, broad at the base, but soon contracting and curving inward. The tip is flat and has a broad, oval outline on the inside, and is strengthened by several imbedded chitinous rods and other pieces. This lobe, by its position and shape, is doubtless homologous with the ordinary outer maxillary lobe, or galea, of the other Orthoptera. Behind the lobe, that is between it and the tongue, lies the ‘horny process’ of Westwood’s description, or ‘fork,’ as I shall call it. This is a slender, more or less curved chitinous rod with a forked bifid tip, and two or three times as long as the outer lobe (plate lxiv, figs. 9 and 10, *f*). The distal portion of the fork, about one-third or less of its length, projects through the lining membrane of the mouth. At this point the fork is stoutest, and from it, it tapers to either end, the outer portion being stouter than the inner. The membrane where it is united with the fork is delicate and elastic, thus permitting the fork to be projected forward or drawn back at will. Within the head the fork is held in position by muscles inserted on its base, which unite it with the lobe and stipes of the maxilla, and by a ligament which runs

backward to the top of the head. Of these muscles one is inserted on the base of the lobe; two others are inserted apparently within the stipes; by their contraction the fork is thrown forward out of the mouth, or moved about. The backward-running cord, which is double, is apparently neither muscular nor the tendon of a muscle, but simply an elastic ligament to draw the fork back, and probably the membrane pierced by the fork aids in the same movement. The fork is still further held in place by the flexor muscles of the stipes and lobe which pass behind it and serve to bind it down against the lobe.

“In the maxilla we have recognized cardo, stipes, and outer lobe, and one naturally asks if the fork is the homologue of the inner lobe of the typical maxilla, or an independent organ. At present I must incline to the latter view, although some may regard the absence of anything else to represent the inner lobe as sufficient evidence of their homology. But there is no articulation of any kind between the fork and the outer lobe, and the peculiarity of the muscular connections seem rather to favor the idea that the fork may represent an independent organ.

“The maxillæ and mandibles occupy the lower half of the large oral cavity which opens above into a thick-walled œsophagus. Below the opening of the œsophagus lies a bone which may be fancifully likened to a lady's bonnet upside down (plate lxiv, fig. 11 and *a. b.* fig. 9); the high front lies along the oral cavity at about half way up; two narrow extensions, representing the bonnet strings, run forward and upward, embracing the œsophagus. The great bundles of short muscles filling the large vaulted clypeus (plate lxiv, fig. 9) are attached to the ends of these strings, and by their contraction close the œsophagus. Just below the ‘front’ a fine duct opens which is the common duct of a pair of lingual glands,

presently to be described. Just below this bone there is a double elevated ridge covered with short hairs (plate lxiv, fig. 11).

“The lower lip (plate lxiv, fig. 10) is composed of an oblong mentum (*m*) bearing a larger labium (*lb*) narrowed at the base, then expanding so as to have a bisinuate, almost S-shaped lateral outline; the lower edge bears two short, broad lobes, and two stumpy, one-jointed * palpi (*l.p.*). The labium in profile (plate lxiv, fig. 9) is very thick, and the lower edge is divided into two narrow laminae, while still a third lamina, well separated from the first two, forms the tongue (plate lxiv, fig. 9, *t*). Within the tongue lie a pair of peculiar organs which may be called the lingual glands (plate lxiv, figs. 9 and 10, *l.g.*); these can be seen through the semitransparent mentum and labium, as in plate lxiv, fig. 10, offering an irregular, obovate outline. A short duct from the lower end of each gland leads into a common duct (*l.d.*) which opens in the œsophageal bone as already described.

“The ducts curve over the lower end of the glands and run up their posterior surface, to which they are soldered nearly to the top. The line of the ducts, together with the lateral outlines, give the glands a three-cornered shape, somewhat like that of a butternut. A little triangular cap fits on the summit of each gland, and on it is inserted a suspensory muscle, the upper end of which is attached to the cranium (plate lxiv, figs. 9 and 10, *g.m.*). The specimens at my command have not been fresh enough to study the histology of these organs, but they seem to be composed of an outer sack, with a thin tough wall which

“* With Westwood I regard these pieces as true palpi, and not as a second pair of labial lobes.”

is light yellow and has a slightly roughened or granular surface. The interior is filled with cells, and perhaps may be glandular. The excretory ducts are thick-walled and strengthened by circular threads, as is often the case with the salivary ducts of *insects."

Scudder in his note "on the structure of the head of *Atropos*," in "Psyche," 1877, vol. ii, p. 49, gives a different account of the fork, saying that "instead of forming a single, simple, rodlike process, this inner lobe [=fork] is three or four times as long as has been presumed, and is two-jointed, the apical point lying, when the organ is at rest, beside the basal joint, which is attached to the maxilla at the extreme base of the latter; the basal joint is directed backward and lies almost directly beneath the basal portion of the apical joint." Mr. Scudder believes that the fork is without any doubt homologous with the customary inner lobe, or lacinia of the maxilla. As will be noted in the foregoing quotation from Burgess, this author believes Scudder's account of the fork as a two-segmented organ to be erroneous, and he inclines to the belief that the fork is an independent organ, and not a part of the maxilla.

COMPARISON AND CONCLUSIONS.

But little special attention need be given to the comparison of the mouth-parts of the Mallophaga with those of the Termitidæ and Perlidæ. The last named families (or orders) show the simple Orthoptero-Neuropterous

"* The salivary ducts in most insects open by distinct apertures into the œsophagus; still, they unite into a common duct in many Diptera and some Orthoptera (see Siebold, Anat. Invert.). Siebold excepts only *Mantis* among the Orthoptera, but *Blatta*, *Termes* and the *Acrydians*, at least, must be added. The occurrence of salivary glands confined within the head is also unusual, but not without precedent."

type of mouth-parts, and offer besides this no special resemblances to the Mallophagous condition. There is no indication in the mouth-parts of the Termitidæ, wingless and specialized though the Termites are, of modifications in the direction of the Mallophagous mouth-parts. In fact, considering the food habits of the Termites and the specialization (by degradation) of their bodies, the mouth-parts show a surprising faithfulness to the simple usual Orthopterous type.

It is in the comparison of the Mallophagous mouth-parts with those of the Psocidæ that such interesting resemblances and parallel or homologous structures appear as to give basis for a belief in the near relationship of the two groups.

The comparison of the mouth-parts of the Mallophaga and the Psocidæ is not made here for the first time. In 1887 Dr. A. S. Packard read a paper before the American Philosophical Society entitled: "On the Systematic Position of the Mallophaga," in which he makes such a comparison. Dr. Packard based his paper on the studies of Melnikow and Grosse on the Mallophaga, and of Burgess on the Psocidæ, and on his (Packard's) own studies. In this paper attention is called to the general similarities shown in the two groups in the position of the mouth structures, due to the great development of the clypeus, in the shape of the mandibles, in the reduction of the maxillæ, etc.

In the light, however, of the preceding detailed accounts of the mouth-parts of *Ancistroneura*, *Læmobothrium*, *Eurymetopus* and *Goniodes* (Mallophaga), with their detailed descriptions of the œsophageal sclerites and glands, and the "forks" of *Ancistroneura* and *Goniodes*, the comparison of the Mallophagous and Psocid mouth structures may profitably be carried farther than has yet been done.

The flattening of the head, with the great development of the clypeus, and the restriction of the mouth-parts to the ventral aspect of the head, so characteristic of the Mallophaga, is quite as characteristic of *Atropos*, the wingless, degraded Psocid. Among the winged Psocidæ the head hangs vertically, and although there is a similar great development of clypeus, there is less flattening of the head and less general resemblance. The peculiar condition of the labrum in the Mallophaga, lying as it does on the ventral aspect of the produced clypeus, finds an identical repetition in *Atropos*; a point which Packard seems to have overlooked when he says that the Mallophaga differ from the Psocids in having the labrum covered by the clypeus. In the winged Psocidæ the head is not horizontal as with the Mallophaga and *Atropos*, and the labrum is attached to the ventral margin of the clypeus.

The mandibles of *Atropos* present a really striking similarity with those of the Amblycerous Mallophaga. The details of teeth, condyles, facets, and musculation are extraordinarily alike.

The maxillæ of the Psocidæ are greatly reduced, retaining, however, a well developed palpus. In the Mallophaga the reduction of the maxillæ is carried still farther, the palpi having become completely atrophied.

The labium of the Psocidæ (of *Atropos* in particular) and of the Mallophaga is modified along essentially similar lines. One important distinction, however, is the presence of well developed labial palpi in one suborder of the Mallophaga.

Not brought out in any previous discussion of the Mallophagous mouth-parts, and, perhaps, more striking than the points of resemblance so far noted, is the practical identity of the œsophageal sclerite and accompanying

glands of the Mallophaga, with the characteristic "œsophageal bone" and glands of the Psocidæ. The comparison of these structures in the two groups reveals an agreement in position and character so nearly identical as to preclude any supposition of independent origin. Also, there is to be noted the presence, in certain genera of the Mallophaga, of a pair of "forks," very much reduced in size, and not yet well understood. These forks seem very like the familiar and characteristic Psocid forks, so far apparently found among no other insects.

It is not intended to discuss here, at all, the probable relationship of the Psocidæ and Mallophaga, simply to point out the peculiar and interesting similarity of mouth structures, as so far brought out in the study of the groups. It is of interest to note in this connection the rather similar food habits of the two groups, the Psocidæ feeding on dry, dead organic matter, such as wood and paper, dried insects, and dried bird and mammal skins; and the Mallophaga feeding on the dry, dead dermal scales, hairs, and feathers of mammals and birds. I have found *Atropos* not infrequently in the nests of birds.

DESCRIPTIONS OF NEW SPECIES.

DOCOPHORUS.

Docophorus taurocephalus n. sp. (Plate lxxv, fig. 1.)

Two males and a female from an American Rough-legged Hawk, *Archibuteo lagopus sancti-johannis* (Lawrence, Kansas). A member of the group dilatoclypeati, found on eagles and hawks and characterized by the more or less prominent, uncolored frontal expansion of the clypeus. The new form resembles Nitzsch's *gonorhynchus* (Giebel, *Insecta Epizoa*, p. 70), from *Astur*

nissus, in the emargination of the clypeus, and it shows, also, what Piaget affirms to be merely an individual character, the effacement of a distinctly limited signature, as spoken of by Nitsch. The new form is markedly larger than *gonorhynchus*, and the male has no transverse linear blotch on the last segment.

Description of male. Body, length 2.06 mm., width 1 mm.; strongly colored.

Head, length .78 mm., width .78 mm.; thus being very large in proportion to the size of the body; front with shallow emargination, the projecting lateral parts angulated; clypeus expanded laterally behind these frontal angles, and the uncolored expanded portion bearing two conspicuous, longish hairs; a short marginal hair just in front of the suture, and two longish hairs rising on dorsal surface and projecting beyond margin between suture and trabeculæ; trabeculæ broad, not reaching beyond end of segment 1 of antenna; eye projecting, pendulous, with angulated cornea, and bearing a hair; temporal margins flatly rounded and bearing four long hairs, and on occipital side of posterior angle a short hair; occipital margin nearly straight, bare; general color of head light translucent brown; signature indistinctly limited, its lateral margins obscured by the strong inner bands; antennal and occipital bands strongly marked and continuous; ocular bands distinctly indicated; suture distinct, interrupting the antennal bands; antennal and inner bands paling anteriorly; temporal regions brown, with narrow darker outer margin.

Prothorax short, broad, with uneven rounding sides, and a single hair in each posterior angle, the angle being slightly tumid; broad, apparently divided, lateral bands pale outwardly, and bending in along the posterior margin of the segment. Metathorax short, with sinuous, very

obtusely angled posterior margin, bearing on the mesal third eight weak, non-pustulated hairs, and in the lateral angles two longer and stronger hairs; large, transverse, lateral blotches separated by a narrow, uncolored, mesal, linear space widening anteriorly; legs pale brown, with dark brown markings on dorsal margins of femora and tibiæ.

Abdomen broadly elliptical, short, segments projecting little or not at all at sides, and with two to three long hairs in posterior angles; a single transverse series of hairs on dorsal surface of each segment; lateral transverse blotches large, and with pointed inner ends; lateral bands darker, not distinctly limited; posterior margin of last segment flatly rounded, with numerous longish hairs which are confined to the lateral portions of the margin.

Female. Body, length 2.53 mm., width 1.04 mm.; head, length .87 mm., width .87 mm.; the lateral abdominal blotches much shorter, the hind body tapering posteriorly, and the ninth segment narrow, uncolored, tapering behind, and narrowly angularly emarginated so as to produce two short acute points.

Docophorus alienus n. sp. (Plate lxxv, fig. 2.)

Found on a Yellow-shafted Flicker, *Colaptes auratus* (Lawrence, Kansas). This species does not resemble any of Nitzsch's or Piaget's *Docophori* taken from woodpeckers, but belongs to Piaget's group *latifrontes*, found on the cuckoos. The group is characterized, according to Piaget, by the width and emargination of the clypeus, and by the large size of the posterior legs. The clypeal characters are presented by this new form, but the posterior legs are not especially enlarged.

Description of the male. Body, length 1.62 mm., width 7 mm.; the only specimen is a recently moulted

one, so that the chitinization is incomplete, and the color is nearly lacking. If it were not for the well marked clypeal characters, which indicate its affinities unmistakably, I should not describe the specimen.

Head, length 56 mm., width 53 mm.; front broad, angularly emarginated; two submarginal hairs between the suture and the anterior angles of the clypeus, of which the hinder is much the longer; a short hair at the suture, and three short ones in front of the trabeculæ; the trabeculæ very long, reaching to end of segment 2 of antennæ; eye prominent, with a hair and black fleck; four longish hairs on temporal margin; occipital and antennal bands pale, but evidently to be well chitinized; signature broad, emarginate on anterior margin.

Prothorax short, with rounding angles, and with single hair in posterior angles; indications of strong, even, lateral bands. Metathorax obtusely angled on abdomen, with a series of pustulated hairs along posterior margin; indications of large lateral blotches. Legs concolorous with body.

Abdomen broadly elliptical, with long hairs in posterior angles of segments, and one transverse row of hairs across each segment; lateral transverse blotches are indicated, and narrow dark lateral bands are present; transverse blotches extending across segment 8; genitalia short, broad, confined to segments 8-9.

Docophorus incisus n. sp. (Plate lxxv, fig. 3.)

Found on a Bluebird, *Sialia sialis* (Lawrence, Kansas), and on a Cedar Waxwing, *Ampelis cedrorum* (Lawrence, Kansas).

General characters of *communis*, but with front of clypeus narrower and deeply emarginated; signature with anterior margin emarginated and unevenly chitinized;

temporal angles more convexly rounded; metathorax obtusely angled on abdomen, and with transverse blotch, with posterior margin not parallel with the posterior margin of the segment; thorax relatively broader than in *communis*. Measurements of male: Body, length 1.72 mm., width .75 mm.; head, length .59 mm., width .56 mm. Female: Body, length 2.12 mm., width .90 mm.; head, length .63 mm., width .63 mm.

***Docophorus domesticus* n. sp.** (Plate lxxv, fig. 4.)

Males, females, and young taken from the Purple Martin, *Progne subis* (Lawrence, Kansas). Most nearly like Nitzsch's *excisus* (Giebel, *Insecta Epizoa*, p. 88, pl. xi, figs. 1, 2, 3) found on *Hirundo urbica* and *Cypselus apus*, but markedly larger. Piaget calls *excisus* one of the smallest *Docophori* known, and gives the average length of the males as 1. to 1.1 mm., and of the females as 1.2. My specimens average in length, males, 1.47 mm., females, 2 mm.

Description of the male. Body, length 1.47 mm., width .59 mm.; thorax and head pale golden brown, with light brown markings; abdomen darker, with large dark brown lateral blotches.

Head, length .5 mm., width .48 mm.; front of clypeus emarginated rather squarely, the bounding mesal angles of the clypeus nearly rectangular; a longish prominent hair rising from the dorsal surface near the margin in each rounded latero-anterior angle of the clypeus, a short marginal hair behind it, another at the suture, two others close together and rising from the dorsal surface near the margin behind the suture, and a single short, marginal hair just in front of the trabeculæ; the trabeculæ large, acutely pointed, reaching middle of segment 2 of antennæ; antennæ, if projected backwards, reach the

posterior margin of the head; eye prominent, with a longish hair; temporal margin with one hair behind, but close to the eye, and two other hairs and two prickles; occipital margin sinuous, bare; signature indistinct, with anterior margin emarginate; no distinct posterior point; occipital bands brown, forking; antennal bands pale smoky brown, interrupted.

Prothorax with rounding sides and angles, rather long, and with a single hair near each end of posterior margin; a broad, even, translucent, lateral band. Metathorax rather long, angulated on abdomen, with a series of pustulated hairs along posterior margin and a broad, lateral, brown band along the antero-lateral sides. Legs robust, pale brown, with dark brown marginal markings and few scattered hairs.

Abdomen broadly elliptical, segments projecting slightly laterally, with one to two or three long hairs in the posterior angles; dorsal surface with numerous weak hairs arranged in transverse lines, a single series on each segment; segments 1-7 with large, dark brown, transverse, lateral blotches, each blotch with an uncolored stigmatal spot, and a few demi-pustulations with hairs along the posterior margin; segment 8 with a curving transverse blotch entirely across segment, and segment 9 wholly colored; a broad uncolored suture between segments 8 and 9; the chitinized parts of the genitalia distinct, short, broad; posterior margin of ninth segment rounded (parabolic) with a few longish hairs.

Female. Body, length 2 mm., width .84 mm.; head, length .56 mm., width .56 mm.; last segment of abdomen with slight angular emargination; genital blotch large, conspicuous.

Docophorus distinctus n. sp. (Plate lxxv, fig. 5.)

Many specimens, males, females, and young, from the American Raven, *Corvus corax sinuatus* (Colorado). This form belongs to the *corvinicolæ* infesting the Corvini and is of the type *atropicti* characterized by the whitish ground color of the body, and sharp black markings. The new species differs from Nitzsch's *atratus* (Giebel, Insecta Epizoa, p. 81, pl. ix, fig. 10) from *Corvus frugilegus* by the long hairs of the clypeus; from Nitzsch's *ocellatus* (Giebel, Insecta Epizoa, p. 81, pl. ix, figs. 7 and 8), from *C. cornix* and *C. corone*, by lacking the strongly marked bands on the temples, and by the short signatures; and differs from Piaget's *albidus* (Les Pediculines, p. 48, pl. iii, fig. 6) from *C. scapularis* by the pustulated hairs of temples and metathorax.

Description of the male. Body, length 2 mm., width 1.06 mm.; ground color whitish with distinct, sharply defined, black markings.

Head, length .63 mm., width .72 mm.; very broad in front and truncate; five long marginal hairs on each side of forehead, one at base of antennæ, one in eye, one just behind the eye, and three on the temporal margins; occipital margin straight, bare; antennæ with segment 1 large and swollen, segment 2 slender and longest, segments 3-5 short, subequal and colored dark brown, segments 1-2 uncolored; signature very short, or at least with only a short, oblong, anterior part colored; antennal bands broad, irregular, interrupted at the suture, and with subparallel inner bands; occipital bands very distinct, diverging and meeting the expanded basal extremities of the antennal bands; ocular bands narrow, distinct, and extending around behind the eye; a shield-shaped occipital signature showing through.

Prothorax narrow, with strong, black, lateral borders,

and a fainter narrow diagonal line running inward and backward from each side; the pericoxal and intercoxal lines of prosternum showing through; one hair in each posterior angle. Metathorax angulated on abdomen, with a series of pustulated hairs along posterior margin; antero-lateral sides with strong black border; postero-lateral sides with paler, brown, linear, tapering blotch. Legs concolorous with body, with black marginal and annular markings.

Abdomen very broadly elliptical, suborbicular; not turbinate; with long weak hairs in posterior angles; last segment flatly rounded behind; the transverse lateral blotches smoky brown, with darker lateral borders, large uncolored stigmatal spots, and about six demi-pustulations along the posterior margin of each blotch; some of the outermost of these pustulations are complete; many weak hairs on dorsal surface; genitalia showing distinctly in segments 6-9, broad and shortly three-pronged posteriorly; segment 8 with transverse blotch entirely across segment; segment 9 uncolored.

Female. Body, length 2.5 mm., width 1.34 mm.; head, length .72 mm., width .81.; abdomen more elongate, the lateral transverse blotches a little shorter, the posterior margin of the last segment with shallow emargination; last segment with two short, longitudinal, lateral blotches; a broad semielliptical genital blotch with backward-projecting mesal point showing through from below.

***Docophorus transpositus* n. sp.** (Plate lxxv, fig. 6.)

A single female from a Cow Bunting, *Molothrus ater* (Lawrence, Kansas). This new *Docophorus* is a member of Piaget's group *forficulati*, whose members have been found hitherto only on the Psittacinae. The distinguishing character of the group is the forcipate clypeal front.

This forcipated clypeus is found also in *D. pertusus* N. (on *Fulica*) of the group *emarginati*.

Description of female. Body, length 2 mm., width .9 mm.; forehead light golden brown, hindhead dark brown, thorax and abdomen strongly blotched with dark brown, abdomen with interrupted narrow, black, lateral bands.

Head, length .56 mm., width .59 mm.; front with a subcircular emargination enclosed in front by mesad-projecting, acute, forceps-like points; no marginal hairs on forehead excepting three or four short ones just in front of trabeculæ; the trabeculæ are rather long, reaching beyond end of segment 1 of antenna; eye with a hair; temporal margins with two longish hairs and a short one between them; occipital margin sinuous, bare; signature broad and very pale, and indistinct anteriorly, with a short, obtuse, posterior point which is darker colored; antennal bands broad, short, paling into general color of forehead; ocular bands fairly distinct, as also the occipital bands; temporal regions dark brown with narrow blackish border outwardly; a narrow black occipital border.

Prothorax with rounding sides and angles, with a single weak hair in each posterior angle; broad, dark brown lateral borders paling outwardly and darkest in posterior angles; two indistinct narrow dark lines running diagonally inward from each lateral border. Metathorax with rounding lateral angles, obtusely angled on abdomen and with a series of pustulated hairs along posterior margin; two linear transversal blackish blotches projecting inward from each side, the anterior blotch much the larger and more distinct. Legs dark brown with blackish marginal markings and semiannulations at extremities of femora.

Abdomen obovate, sides somewhat turbinate but with the projecting angles rounded; segments 3-6 with two

or three short hairs in posterior angles, segment 7 with one hair in angle; segment 8 much narrower than segment 7 and somewhat retracted into it; segment 9 hardly visible, being almost wholly concealed within segment 8; segment 1 with complete transverse blotch deeply medianly emarginated on its anterior margin; segments 2-7 with lateral, dark brown, transverse blotches separated by the paler median third of the body surface and blunt within; each blotch with a distinct uncolored stigmal spot, but without pustulated hairs; blotch of segment 8 extending entirely across segment; four longitudinal rows of weak nonpustulated hairs, two rows in median paler space, and one row in each lateral series of transverse blotches; distinct, black, lateral bands widening posteriorly and segmentally interrupted.

Docophorus evagens n. sp. (Plate lxvi, fig. 2.)

Taken from the Downy Woodpecker, *Dryobates pubescens* (Lawrence, Kansas). This *Docophorus* is a member of Piaget's woodpecker infesting group *angustifrontes*, characterized by the anterior narrowing of the head with small trabeculae, and the elongate Nirmoid form of the body. It departs from the more typical forms of the group, however, in the relatively wide clypeal front.

Description of male. Body, length 2 mm., width .62 mm.; body color pale yellowish brown, with narrow dark brown marginal markings.

Head, length .53 mm., width .47 mm.; triangular but relatively longer, and with wider frontal apex than in other *Docophori* of this group; two very short hairs in anterior clypeal angles, one at suture and two in front of trabeculae; the trabeculae are acute and reach to the end of segment 1 of antennae; antennae slender; eye not prominent, with a hair and small black fleck; temporal

margins with two longish hairs; occipital margin weakly concave, almost straight and bare; narrow antennal bands, and temporal borders shining dark brown.

Prothorax short, with narrow marginal band and no hairs. Metathorax acutely angled on abdomen, the angle produced; beginning in lateral angle five long hairs along each latero-posterior margin, the mesal third of the posterior margin being free from hairs; a narrow, indistinct, lateral border. Legs concolorous with body, with narrow, dark brown, marginal markings. Sternum with narrow distinct intercoxal lines.

Abdomen elongate, subparallel-sided; a single longish hair in posterior angles of segments 3-4, and two hairs in angles of segments 5-8; two hairs also in middle of lateral margin of segment 8; segment 9 uncolored, narrowed and slightly emarginated behind; narrow, translucent, brown lateral bands, and faint indications of median transversal blotches which are probably the light brown transversal blotches of the under side showing through.

***Docophorus jungens* n. sp.** (Plate lxvi, fig. 4.)

Found on two specimens of the Flicker, *Colaptes auratus* (Lawrence, Kansas). The new form belongs to Piaget's group *angustifrontes*, found on the woodpeckers, and presents the characteristic narrow clypeal front, the small trabeculæ, and elongate Nirmoid body. The members of the group undoubtedly stand in the position of gradatory forms between *Docophorus* and *Nirmus*.

Description of the male. Body, length 1.75 mm., width .65 mm.; very pale brownish, with darker marginal markings.

Head, length .56 mm., width .50 mm.; triangular, with narrow, anteriorly tapering clypeus which is concave in

front; two short hairs just beyond the anterior angles, one short hair at the suture, and two slightly longer ones in front of the rather small trabeculæ; eye distinct, with a long hair; temporal margins flatly convex, with two long hairs; occipital margin weakly concave and sinuous, bare; ground color of head pale yellowish brown with narrow dark brown antennal bands, pale colored signature and narrow brown temporal margins fading out posteriorly; œsophageal sclerite showing through, and occipital bands indicated, especially at their posterior ends.

Prothorax small, with slightly rounded rectangular posterior angles and straight posterior margin, with one hair in posterior angles; pale lateral borders which bend inward at posterior angles. Metathorax short, broad, angulated on abdomen, with indistinct lateral blotch and six hairs along each latero-posterior margin arranged in two groups of three each. Legs concolorous with the pale body, with darker marginal blotches on femora and tibiæ.

Abdomen narrow, with few longish hairs in posterior angles of segments and a transverse series of a few longish hairs across each segment interrupted in the middle; lateral bands translucent pale brown, the segmental portions passing the sutures and projecting somewhat inward; indications of median transverse bands; last segment conspicuous, projecting, flatly rounded behind, and with a few longish hairs; genitalia showing through body wall.

Female. Body, length 1.93 mm., width .68 mm.; head, length .56 mm., width .58 mm.; abdomen more elongate and subparallel-sided; eighth segment with transverse blotch entirely across segment; ninth segment slightly angularly emarginate behind.

Docophorus californiensis n. sp. (Plate lxvi, fig. 6.)

Numerous specimens, male, female, and young from several specimens of the California Woodpecker, *Melanerpes formicivorus bairdi* (Palo Alto, California). Another member of the *angustifrontes*, of same size and outline as the last, but with strong and characteristic markings. It is very like *D. superciliosus* N. (Giebel, Insecta Epizoa, p. 94, pl. x, fig. 3), the type of the group taken by Nitzsch, Denny, and Piaget from *Picus major* and *P. viridis*. It appears to differ from *superciliosus* in the possession of hairs in the posterior angles of the prothorax, in the absence of numerous hairs on dorsal surface of abdomen, and in the sharper and more pronounced markings.

Description of the male. Body, length 1.75 mm., width .62 mm.; pale smoky brown, with dark brown to black bands and blotches.

Head, length .53 mm., width .47 mm.; triangular, forehead tapering, and clypeal front narrow and slightly concave, with two hairs in the anterior angles, one shorter one between angle and suture, a longer one just in front of suture, and two rather long ones in front of trabeculæ; eye prominent, with long hair; trabeculæ acute, reaching slightly beyond end of segment 1 of antennæ; temporal margins with two long hairs and a prickle; occipital margin sinuous, bare; clypeus paler than rest of forehead and hind head; signature pale but distinct; suture distinct; antennal bands, ocular blotch, and anterior temporal border blackish brown; temporal regions and rest of head, excepting clypeus and that part of hind head between the occipital bands, dark brown; œsophageal sclerite distinct.

Prothorax short, projecting considerably beneath head; posterior angles rectangular, with one hair; posterior mar-

gin evenly flatly convex; lateral border curving inwards along posterior margin blackish brown. Metathorax short; lateral angles obtusely rounding; posterior margin with obtuse produced angle and four or five hairs on each side; uneven lateral border and transverse blotch not contiguous to posterior margin, dark brown. Sternal markings consisting of intercoxal lines. Legs concolorous with pale smoky brown of body, with black marginal markings.

Abdomen elongate, about one-third wider than head, with few long hairs in very slightly projecting posterior angles of segments; a few hairs arranged in five uneven, longitudinal rows on dorsal surface; broad, pronounced, blackish, lateral bands, with distinct uncolored stigmatal spots and broad transverse blotches extending from band to band on segments 1-8; the blotches on segments 1-2 deeply emarginated medially on anterior margin, and the blotch on segment 7 faint in median part; segment 9 projecting, rounding, with several long hairs on posterior margin and a median blotch; genitalia showing in segments 7-9.

Female. Body, length 1.9 mm., width .72 mm.; head, length .6 mm., width .53 mm.; last segment of abdomen slightly angularly notched.

Docophorus cursor Nitzsch. (Plate lxvi, fig. 1.)

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1861, vol. xvii, p. 527.

Phlopterus cursor N., Walckenaër, Hist. Nat. Ins. Apt.; 1844, vol. iii, p. 341.

Docophorus cursor N., Burmeister, Handb. d. Ent., 1835, vol. ii, p. 426;

Denny, Monograph. Anoplur. Brit., 1842, p. 101, pl. ii, fig. 1;

Giebel, Insecta Epizoa, 1874, p. 75, pl. xi, figs. 5, 6; Piaget, Les

Pediculines, 1880, p. 24, pl. i, fig. 5.

Many specimens from a Great Horned Owl, *Bubo virginianus* (Lawrence, Kansas). Nitzsch's type specimens were collected from *Strix bubo*, and he later took speci-

mens from *Strix otus* and *Strix brachyotus*. Denny collected the species from *Otus (Strix) vulgaris* and *Otus (Strix) brachyotus*, and Piaget from *Strix brachyotus* and from *Falco tinnunculus*. Picaglia (Pediculini dell' istituto anatomo-zoologico d. r. Univ. di Modena, Atti d. Soc. d. Nat. di Modena, 1885, ser. iii, vol. iv, p. 13) records *Bubo maximus*, *Otus vulgaris*, *O. brachyotus*, and *Tinnunculus alaudarius* as hosts of *cursor*. There is some discrepancy between Giebel's and Piaget's description of the species, especially touching the lateral emargination of the forehead, a character which, according to Piaget, is noticeable, and which indicates the affinities of *cursor* and the hawk-infesting *Docophori*. My specimens vary noticeably from the descriptions of the Old World forms, especially in the distinctly pendulous eye and the character of the genital blotches. They are also larger than the European specimens. Probably they should be given a varietal name. The species may be recognized by comparison with the figure. In the male the lateral abdominal blotches cover much more of the abdominal surface of course, and the specimens are smaller. My specimens measure—Male: Body, length 1.9 mm., width .75 mm.; head, length .62 mm., width .62 mm. Female: Body, length 2.22 mm., width .9 mm.; head, length .66 mm., width .66 mm.

Docophorus ceblebrachys Nitzsch (Plate lxvi, fig. 3).

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1861, vol. xvii, p. 528.

Docophorus ceblebrachys N., Denny, Monograph. Anoplur. Brit., 1842, p. 92, pl. i, fig. 3; Giebel, Insecta Epizoa, 1874, p. 77, pl. xi, fig. 15; Piaget, Les Pediculines, 1880, p. 29, pl. i, fig. 8.

Numerous specimens from two Snowy Owls, *Nyctea nyctea* (Lawrence, Kansas). Taken by Nitzsch, Denny and Piaget on individuals of the same bird species. A distinctly marked and isolated form peculiar, probably, to

the Snowy Owl. It can be readily recognized by the broad short head, with short broadly truncate forehead, and correspondingly short and broad signature. The genital blotches of the ventral surface of the abdomen of both male and female are also characteristic. There is considerable difference in size of the male and female. The male which I figure measures: Body, length 1.78 mm., width .75 mm.; head, length .53 mm., width .6 mm. Female: Body, length 2.31 mm., width 1.03 mm.; head, length .62 mm., width .75 mm.

***Docophorus rostratus* Nitzsch.** (Plate lxvi, fig. 5).

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1861, vol. xvii, p. 529.

Docophorus rostratus N., Giebel, Zeitschr. f. ges. Naturwiss, 1861, vol. xviii, p. 296; Burmeister, Handb. d. Ent., 1835, vol. ii, p. 427; Denny, Monograph. Anoplur. Brit., 1842, p. 87, pl. ii, fig. 4; Giebel, Insecta Epizoa, 1874, p. 76, pl. x, fig. 4; Piaget, Les Pediculines, p. 27, pl. i, fig. 7.

Two specimens of this unmistakable *Docophorus*, taken by Nitzsch, Denny and Piaget from *Strix flammea*, the European Barn Owl; taken by me from the American Barn Owl, *Strix pratincola* (Soquel, California). The American Barn Owl has always, until recently, been held to be simply a variety (*Strix f. pratincola*) of the European Barn Owl. The specimen figured by me measures: Body, length 1.97 mm., width .5 mm.; head, length .75 mm., width .53 mm. The species is readily recognizable by its slender abdomen and its very long head, with narrow extended forehead. The head and thorax are longer than the abdomen.

***Docophorus communis* Nitzsch.** (Plate lxvi, fig. 7.)

Germer's Mag. f. Ent., 1818, vol. iii, p. 290.

The following synonymy is that given by Picaglia in his Pediculini dell 'Istituto anatomo-zoologico della R.

Universita di Modena, Atti della Societa dei Naturalisti di Modena, Serie 3, vol. iv, 1895.

“Sinonimia—De-Geer. Mem. Ins. vol. vii, tv. 4, f. 9. 1776 (*Ricinus emberizæ*)—Schrank. Beit. zur Naturg. p. 117, tv. 5, f. 8. 1776 (*Pediculus curvirostræ*)—l. c. p. 117, f. 6 (*P. Pyrrulæ*)—l. c. p. 118, f. 7 (*P. Chloridis*)—l. c. p. 116, f. 9 (*P. citrinellæ*)—l. c. p. 115, f. 10 (*P. Rubeculæ*)—Linneo. Syst. Nat. Ed. xiii, v. ii, p. 2922. 1789 (*P. curvirostræ*, *Pyrrullæ*, *Chloridis*, *Citrinellæ*, *Rubeculæ*)—Panzer. Fau. Ins. Germ. p. 51, f. 27. 1793 (*P. Curvirostræ*)—Geoffroy. Hist. abr. Ins. v. 11, p. 599. 1800 (*Pediculus Emberizæ*)—Latreille. Hist. Gen. v. viii, p. 111. 1804 (*Ricinus Emberizæ*)—Fabrieus. Sys. Ant. p. 349. 1805 (*P. Emberizæ*)—Olfers. De Veg. et. Anim. Corp. Anim. Rep. 1815 (*Nirmus globifer*)—Nitzsch. Germ. Mag. v. iii, p. 290. 1818—Burmeister. Hand. Ent. v. ii, p. 425. 1835—l. c. (*fuscicollis*)—Denny. Anop. p. 70, tv. 5, f. 10. 1842—l. c. p. 82, tv. 1, f. 8 (*pallescentis*)—l. c. p. 98, tv. 1, f. 8 (*fuscicollis*)—l. c. p. 104, tv. 5, f. 12 (*Passerinus*)—l. c. p. 106, tv. 3, f. 1 (*Merulæ*)—l. c. p. 107, tv. 3, f. 3 (*Modularis*)—l. c. p. 108, tv. 2, f. 2 (*Rubeculæ*)—Walekenær. Hist. Nat. Ins. Apt. v. iii, p. 332. 1844 (*Philopterus*)—l. c. p. 336 (*Philopterus pallescens*)—l. c. (*Philopterus fuscicollis*)—l. c. p. 340 (*Philopterus passerinus*, *merulæ*, *modularis*, *rubeculæ*)—Giebel. Zeits. f. ges. Nat. Bd. xvii, p. 298-303. 1861—l. c. (*fuscicollis*) p. 298—l. c. Bd. xviii, p. 298-303. 1861—l. c. p. 298. 1861 (*fuscicollis*)—Giglioli, Jour. of Micros. N. 10, tv. B, f. 9. 1864 (*Mandarinus*)—Giebel. Zeits. f. ges. Nat. Bd. xxvii, p. 116. 1866 (*ornatus*)—l. c. Bd. xxvii, p. 358. 1866—l. c. p. 359 (*fuscicollis*)—l. c. p. 359 (*ornatus*)—Epiz. p. 85, tv. xi, f. 13. 1884—l. c. p. 86, tv. 11, f. 10, tv. 20, f. 4 (*fuscicollis*)—l. c. p. 89 (*ornatus*)—l. c. p. 120 (*Rubeculæ*, *Modularis*, *Merulæ*)—l. c. p. 119 (*turdi*)—l. c. p. 91 (*lineatus*)—Piaget. Ped. p. 54, tv. 4, f. 2, 3, 4, 5, 7 (sp. et var.).”

The specific name *communis* given by Nitzsch to a *Docophorus* species or group of closely allied species found commonly on passerine birds, has been retained by Giebel and Piaget as the best, or, at least, most convenient expression of the condition exhibited by the *Docophori* of the type figured by Nitzsch from specimens from *Fringilla linaria*, and by Piaget from specimens from *Motacilla alba* and others. Specimens of this type are the most commonly met with *Docophorus* on

passerine birds, and have been recorded from many species. Picaglia (l. c., p. 16) lists 43 species of European Passeres from which *communis* has been collected. But the variations exhibited by the specimens from the various bird species are many and sometimes striking. Giebel refers to variations exhibited by specimens from certain birds as being sufficient to warrant the founding of new species, but he merely refers to the general character of the variation shown by specimens from *Turdus pilaris*, *Parus major*, *Fringilla chloris*, and *Motacilla alba*. He lists 29 passerine birds representing 15 genera on which *communis* had been found at time of his writing. Piaget holds to the single species *communis*, referring to the variations apparent in any series of specimens, and describes and gives varietal names to 11 varieties. He selects the form found on *Motacilla alba* as typical of the species (believing it to be the same as found by Nitzsh on *Fringilla linaria*) and lists nearly 20 passerine bird species on which he has found *communis* and its varieties.

I have collected specimens of this *communis* species or group of species from the following American passerine birds: the Horned Lark, *Otocoris alpestris*; Red-winged Blackbird, *Agelaius phoeniceus*; Western Meadowlark, *Sturnella magna neglecta*; Lapland Longspur, *Calcarius lapponicus*; Slate-colored Junco, *Junco hyemalis*; Cardinal Grosbeak, *Cardinalis cardinalis*; Bohemian Waxwing, *Ampelis garrulus*; White-rumped Shrike, *Lanius ludovicianus excubitorides*; Brown Thrasher, *Harporhynchus rufous*; and the Robin, *Merula migratoria*—all from Lawrence, Kansas; and also from Bullock's Oriole, *Icterus bullocki*; the California Purple Finch, *Carpodacus purpureus californicus*; the House Finch, *Carpodacus mexicanus frontalis*; the Pine Siskin, *Spinus pinus*; the Arkansas Goldfinch, *Spinus psaltria*; and the Sand-

wich Sparrow, *Amodramus sandwichensis*, from Palo Alto, California.

Variations among the specimens are apparent, but until I can examine a much larger series no attempt can be made to tabulate these variations. The species may be recognized by comparison with the figure in plate lxvi. This specimen, a female, was taken from a White-rumped Shrike, *Lanius ludovicianus excubitorides* (Lawrence, Kansas), and measures: Body, length 2. mm.; width .87 mm.; head, length 6 mm.; width .6 mm.

Docophorus excisus Nitzsch.

Germar's Mag. f. Ent., 1818, vol. iii, p. 291.

Pediculus hirundinis Linnæus, Fau. Suec., 1746, p. 1963; Schrank, Fauna Boica, 1781; Fabricius, Sp. Ins., 1783, vol. ii, p. 483; Linnæus, Syst. Nat., ed. 13, 1779, vol. i, p. 2921.

Ricinus hirundinis Latreille, Hist. Gen., 1804, vol. viii, p. 111.

Philopterus excisus Nitzsch, Germ. Mag. f. Ent., 1818, vol. iii, p. 291; Burmeister, Handb. d. Ent., 1835, vol. ii, p. 425; Walckenaer, Hist. Nat. Ins. Apt., 1844, vol. iii, p. 333.

Docophorus excisus Nitzsch, Giebel, Zeitschr. f. ges. Naturwiss., 1861, vol. xviii, p. 298, l. c. 1866, vol. xxviii, p. 359; Giebel, Insecta Epizoa, 1874, p. 88, pl. ix, figs. 1, 2, 3; Piaget, Les Pediculines, 1880, p. 64, pl. iv, fig. 6.

Specimens which may be referred to this long known parasite of the swallows taken from the Cliff Swallow, *Petrochelidon lunifrons*, and from the Tree Swallow, *Tachycineta bicolor* (Palo Alto, California, and Lawrence, Kansas). The American specimens are, however, markedly larger than the European ones and should be designated by a varietal name. Piaget's measurements are, for males, length 1 m., for females 1.1 mm.; the males among my specimens are about 1.3 mm. long and the females 1.5 mm. long. The species of this group (with square emargination of clypeal front) which I have described from the Purple Martin (see page 475, plate lxv, fig. 4) shows all of the general habitus of *excisus*, but is

so conspicuously larger and presents such constant minor differences that I have made it the type of a new species. The figure of it, however, will serve very well as a means of recognizing the American variety of *excisus*.

Var. *major* Kellogg. Male. Body, length 1.3 mm., width .56 mm.; head, length .44 mm., width .40 mm. Female. Body, length 1.49 mm., width .62 mm.; head, length .45 mm., width .42 mm.; the pustulations in lateral abdominal blotches more complete and distinct than in the type form of the species. Males, females, and young found on the Cliff Swallow, *Petrochelidon lunifrons*, and on the Tree Swallow, *Tachycineta bicolor* (Palo Alto, California, and Lawrence, Kansas).

NIRMUS.

Nirmus longus n. sp. (Plate lxvii, fig. 1.)

Taken from the Tree Swallow, *Tachycineta bicolor* (Lawrence, Kansas), and from the Cliff Swallow, *Petrochelidon lunifrons* (Palo Alto, California). A member of the group *interruptofasciati* and allied to Nitzsch's *N. gracilis* (Insecta Epizoa, p. 143, pl. vi, figs. 11, 12), which is only half as large and has but four (Giebel) or two (Piaget) hairs on posterior margin of metathorax, and to Denny's *elongatus* (Monograph. Anoplur. Brit., p. 140, pl. vii, fig. 4), which has the posterior margin of the metathorax "strongly ciliate," the hairs in Denny's figure being ranged thickly along the entire length of the margin. Both of these two allied species were taken from *Hirundo urbica*.

Description of female. Body, length 2.03 mm., width .38 mm.; very elongate, pale yellowish brown, with chestnut brown lateral bands and marginal head markings.

Head, length .37 mm., width .28 mm.; elongate-conical, with narrow truncate front; two very small marginal hairs near the front, and one slightly longer a little distance in front of the trabeculae which are small but distinct; eye flat, with a prickle in its posterior margin; temporal margins flat with a long hair and a prickle; pale golden brown with dark brown narrow antennal bands and temporal borders; oral fossa elongate, expanded behind, nearly uncolored.

Prothorax short, small, oblong, with single short hair in posterior angle, and even lateral borders which bend inward along posterior margin. Metathorax trapezoidal, with lateral margins converging anteriorly; posterior margin straight or weakly convex on abdomen, more curved at each end which projects laterally beyond the abdomen; posterior margin with six longish but weak hairs on each lateral third; indistinct lateral borders with anterior ends more distinct and a diagonal line projecting inward and forward from the posterior angles. No pronounced sternal markings. Legs pale, concolorous with body, with narrow darker marginal markings.

Abdomen very long and apparently slender, although really one-third wider than head; abdominal segments very gradually growing wider until segment 6 is reached, segment 7 slightly narrower, segments 8-9 narrower, abruptly tapering; a single short hair in posterior angles of segments; dorsal surface naked; segments 1-7 with distinct chestnut brown lateral bands; segment 8 of general body color; segment 9 uncolored, emarginated behind, with rounded points.

Male. Two males, which with much hesitancy I assign to this species, taken from a Cliff Swallow, *Petrochelidon lunifrons* (Palo Alto, California), are much smaller than the females. This condition is similar to that pre-

sented by *gracilis*, the males of which are .7 mm. long, while the females are .95 mm. long. The arrangement and number of metathoracic hairs are the same as in the females, and the head characters agree. Measurements of the male: Body, length 1.47 mm., width .43 mm.; head, length .34 mm., width .31 mm.

Nirmus simplex n. sp. (Plate lxvii, fig. 2.)

Found on a Robin, *Merula migratoria* (Lawrence, Kansas). It belongs to Piaget's group *interruptofasciati*, with antennal bands interrupted, with temples tending to become angular, and with the body blotches indistinctly colored.

Description of female. Body, length 1.77 mm., width .62 mm.; very pale yellowish brown, with darker but inconspicuous markings.

Head, length .53 mm., width .50 mm.; bluntly triangular, the rather narrow clypeal front truncate or very weakly concave; a single short hair in anterior angles and two other shorter ones on lateral margins; trabeculae small, acute; eye flat, with a prickle in posterior edge; temporal margins flatly convex, with a single long hair and two prickles just in front of it; occipital margin straight, bare; signature indistinctly colored, broad, emarginate in front and truncate behind; antennal bands distinct, narrow and finely crenate on inner margin; occipital bands indistinct, narrow, extending to posterior rami of mandibles; temporal margins for a little distance behind eye narrowly bordered; antennae uncolored, fifth segment longer than third or fourth.

Prothorax short, broad, with lateral margins converging anteriorly; a single strong hair in posterior angles; posterior margin flatly convex; rather broad lateral borders, which extend inward along the posterior margin.

Metathorax broad, short, obtusely angled on the abdomen, with a series of non-pustulated hairs along posterior margin; a lateral marginal blotch with a part extending inward. Legs concolorous with body, with only faintly indicated marginal markings.

Abdomen bluntly elliptical, one-fifth wider than the head; with one to two or three weak hairs in posterior angles of segments, and a single transverse series of short weak hairs along the posterior margin of each segment; translucent, smoky brown lateral bands, and pale brown, broad, transverse blotches entirely across all segments; distinct uncolored stigmal spots; segment 9 uncolored, with two small pale brown lateral blotches, slightly emarginated behind, and with a few longish hairs.

Nirmus eustigmus n. sp. (Plate lxvii, fig. 3.)

A single female of this well marked form from an Anna's Hummingbird, *Trochilus anna* (Palo Alto, California). The species belong to Piaget's group *interruptofasciati*. It is a much broader and much more robust form than *N. vulgatus*, the *Nirmus* of this group common among passerine birds, and the lateral bands of the abdomen are broad and pronounced.

Description of the female. Body, length 1.84 mm., width .62 mm.; pale yellowish white, with narrow blackish brown head borders, and broad, blackish lateral abdominal bands; indications of pale brown abdominal blotches.

Head, length .42 mm., width .45 mm.; broadly triangular, narrowly truncate in front; a few short weak hairs along margins of forehead, the longest being a pair considerably in front of the trabeculæ; trabeculæ small and uncolored but distinct; antennæ short, segment 2 most

colored, segment 3 next; eye with a prickle; temporal margins with a single long hair and some fine prickles; occipital margin straight, bare; antennal bands blackish brown, not quite meeting in front, leaving a small uncolored space on frontal margin, and bending angularly in at posterior ends; narrow blackish brown ocular and temporal margins, paling gradually inward from margin of head.

Prothorax short, rectangular, with a single hair in posterior angles; blackish brown lateral borders. Metathorax trapezoidal, posterior margin very flatly convex on abdomen, with an angular indication at middle; six pustulated hairs on each outer third of the posterior margin; broad, ill-defined lateral border, with transversal lateral blotch extending from each side. Legs pale, with blackish brown dorsal marginal markings. Sternum with intercoxal lines but no median blotches.

Abdomen, elliptical; broad for this group of *Nirmi*, with posterior angles of segments, uncolored, blunt, projecting slightly; two or three hairs in posterior angles and a series of four longish hairs on the posterior margin of each of segments 2-7; segment 1 without hairs and segment 8 with more than four hairs; whitish, with distinct broad, blackish lateral bands, and pale brownish median blotches; segment 8 without lateral bands, but with narrow transversal median blotch reaching almost entirely across segment; segment 9 uncolored, slightly angularly emarginated behind.

Nirmus illustris n. sp. (Plate lxvii, fig. 4.)

Found on a Red-winged Blackbird, *Agelaius phœniceus* (Lawrence, Kansas). This small but striking *Nirmus* does not show special resemblance to any previously described species.

Description of male. Body, length 1.56 mm., width .52 mm.; whitish, with brown median blotches and black marginal bands.

Head, length .37 mm., width 37 mm.; truncate or very slightly convex in front, with two or three very short indistinct marginal hairs; trabeculæ small and weak, reaching half way to segment 1 of antennæ; eye indistinct, with a fine prickle; temporal margins with two prickles and a weak hair; occipital margin straight, bare; antennæ with segment 1 uncolored; other segments dark brown, with wide uncolored sutures; antennal bands narrow, black, angulated almost at right angles and with the black color interrupted just in front of the angulation; bases of antennal bands meeting the inner ends of distinct, narrow, ocular bands whose outer ends meet anterior ends of narrow black temporal borders, with inner margins slightly crenate; short black internal bands parallel with anterior marginal parts of antennal bands; a shield-shaped occipital signature and oblong blotches at its sides showing through from under side.

Prothorax with flatly rounded sides and rounded posterior angles, each angle bearing one small hair; anterior angles containing a large dark brown blotch, and intercoxal lines of sternum showing through as black diagonal lines in posterior angles. Metathorax with rounding margins, rounded on abdomen, with five weak hairs in each lateral fourth of the posterior margin; small black linear blotches in anterior angles, and large irregular black lateral blotches not contiguous to the lateral margins, the sternal markings showing through dark chestnut brown. Sternal markings consisting of intercoxal lines and a median blotch on metasternum. Legs, femora and tibiæ with dorsal marginal black markings and a blackish brown annulation near distal extremity; tarsi paler brown.

Abdomen elongate, subparallel-sided, with posterior angles of segments projecting slightly, pointing backward and each bearing two weak hairs; dorsal surface of segments naked; last segment projecting, parabolic behind, with two pairs of long weak hairs and one pair of shorter ones; lateral bands narrow, distinct, black, interrupted, the anterior end of each segmental portion projecting beyond the suture and slightly inward; large median chestnut brown blotches on segments 1-7, each of these blotches (except that on segment 1) nearly crossed by a transverse linear uncolored space; on segments 6-7 the uncolored space is divided into two portions; in addition there are on segments 3-7 a pair of transversal dark brown lines, one on each side of the median line and lying superposed on median blotch, but extending a little farther laterally than the lateral margin of the blotch; some of these markings are on the ventral surface, but show through distinctly; segment 8 has a median blotch and two lateral markings composed of a brown line defining an elongate curving triangle, uncolored within; segment 9 has a median blotch and from its posterior margin two anteriorly projecting lines; distinct, slender, curving side pieces of genitalia limited to segment 8.

Nirmus vulgatus n. sp. (Plate lxvii, fig. 5.)

This small *Nirmus* of Piaget's group *interruptofasciati* is rather common on Passerine birds. I have taken it from the California Purple Finch, *Carpodacus purpureus californicus*; the House Finch, *Carpodacus mexicanus frontalis*; the Golden-crowned Sparrow, *Zonotrichia coronata*; Gambel's Sparrow, *Zonotrichia gambeli*; the Spurred Towhee, *Pipilo maculatus megalonyx*; the California Towhee, *Pipilo fuscus crissalis*; all from Palo Alto, California; and from the Slate-colored Junco, *Junco*

hyemalis, and the Robin, *Merula migratoria*, from Lawrence, Kansas.

It is allied to Nitzsch's *densilimbus* (*Fringilla carduelis*) (Giebel, *Insecta Epizoa*, p. 138), Piaget's *deficiens* (Les Pediculines, Supplement, p. 23, pl. iii, fig. 3) from *Cyanopolius cooki*, and other similar forms.

Description of female. Body, length 1.62 mm., width .41 mm.; pale, with distinct narrow blackish brown lateral bands and marginal head markings, and pale chestnut median abdominal blotches.

Head, length .37 mm., width .29 mm.; conical, with narrow parabolic front, without hairs; trabeculae very small and uncolored but distinct; eye flat, with a fine prickle, and another just at its posterior margin; temporal margins with one longish hair and two prickles; occipital margin straight, bare; no signature; a longitudinal oral fossa expanded laterally behind; whole head narrowly bordered along lateral margins with blackish brown, the border turning angularly inward at antennal fossae; a pale shield-shaped occipital signature showing through from below.

Prothorax narrow, quadrangular, with a single hair in posterior angles; narrow lateral blackish brown border, most strongly colored in anterior and posterior angles. Metathorax almost as wide as head, with flatly rounding posterior margin, with six hairs along each lateral third of this margin, a small transversal linear blackish blotch in anterior angle, and a larger lateral irregular curving blackish blotch in middle of lateral regions of segment. Legs with pale brown ground color, mostly tinged with translucent smoky brown and with darker marginal and annular markings.

Abdomen clongate, slender, subparallel-sided, not tapering posteriorly until segment 8 is reached; with short

weak single hairs in posterior angles of segments and naked dorsal surface; pale ground color, with narrow, distinct, dark brown lateral bands and paler broad, rectangular transverse blotches, darker on posterior segments; a rather broad uncolored median longitudinal line; segment 1 with transverse blotch entirely across segment; segment 9 uncolored, narrowly notched, and with few long but weak hairs.

Male. Body, length 1.47 mm., width .4 mm.; head, length .33 mm., width .28 mm.; last abdominal segment protruding, narrowly rounded, with a pair of hairs (one longish, one short) on each side of the middle of the posterior margin; genitalia composed of narrow bars, and showing through in segments 8 and 9.

Nirmus discocephalus Nitzsch. (Plate lxxvii, fig. 6.)

Germar's Mag. Entomol., 1818, vol. iii, p. 291.

Nirmus discocephalus Nitzsch, Burmeister, Handbuch d. Ent., 1835, vol. ii, p. 430; Denny, Monograph. Anoplur. Brit., 1842, p. 113, pl. ix, fig. 10; Giebel, Insecta Epizoa, 1874, p. 127, pl. vii, fig. 10; Piaget, Les Pediculines, 1880, p. 129, Supplement, 1885, p. 18, pl. ii, fig. 7.

My specimens, taken from a Bald Eagle, *Haliæetus leucocephalus* (Lawrence, Kansas), may be referred to this characteristic *Nirmus* species of the eagles, found by Nitzsch, Denny and Piaget on the European Gray Sea Eagle, *Haliæetus albicilla*; but the variations in number of metathoracic hairs and in other particulars make it desirable to distinguish the forms from the American bird by a varietal name. The descriptions and figures of Nitzsch, Denny and Piaget differ from one another with regard to the shape of the head, number of metathoracic hairs, etc., to a surprising degree, in view of the fact that all the specimens examined were from the same bird species.

Var. *amblys* Kellogg. Males, females, and young from the Bald Eagle, *Haliæctus leucoccephalus* (Lawrence, Kansas). Male, body, length 1.56 mm., width .60 mm.; head, length .47 mm., width .46 mm. Female, body, length 2 mm., width .75 mm.; head, length .52 mm., width .53 mm. Characters of the species as described by Piaget (Supplement, 1885, p. 18, pl. ii, fig. 7), but with head not longer than wide, eyes with a hair, prothorax with a long hair in each posterior angle, metathorax with a spine in each lateral angle and six long hairs on each lateral fourth of the posterior margin.

Nirmus fuscus Nitzsch. (Plate lxvii, fig. 7.)

Zeitschr. f. ges. Naturwiss. (ed. Giebel) 1861, vol. xvii, pp. 523-525.

Nirmus fuscus N., Denny, Monograph. Anoplur. Brit., 1842, p. 118, pl. ix, fig. 8; Giebel, Insecta Epizoa, 1874, p. 123, pl. viii, fig. 2; Piaget, Les Pediculines, 1880, p. 130, pl. x, fig. 9.

Specimens of a large variety of this *Nirmus* of the Eagles and Hawks from Swainson's Hawk, *Buteo swainsoni*; from the Marsh Hawk, *Circus hudsonius*; and from the American Roughlegged Hawk, *Archibuteo lagopus sancti-johannis*—all from Lawrence, Kansas. The American form of *fuscus* (if it be not a new species, indeed) differs markedly from the European type or any of its rather many varieties by being much larger, my specimens being fully one-third larger than the *fuscus* specimens taken from *Buteo vulgaris* by Nitzsch and Piaget. If the various species of Giebel, *fuscus*, *stenorhynchus* and *leucopleurus* (Insecta Epizoa, pp. 124, 129), be only varieties of *fuscus* as Piaget believes (Les Pediculines, p. 131), then *fuscus* has been taken from *Buteo vulgaris*, *Milvus ætoliæ*, *Falco brachydactylus*, *Parus cæruleus*!, *Aquila nævia*, *Circus rufus*, *Milvus ietinus*, *Ardea gularis*! (Piaget), *Archibuteo lagopus*, *Circus cyaneus*, *Circus æruginosus* and *Milvus regalis*. If in addition

rufus N. with its numerous varieties belongs to the same species, nine or ten more hawk hosts should be enumerated. Without doubt this *Nirmus* type (elongate, with circumfasciate head, broad transverse median abdominal blotches, and distinct lateral bands with the segmental parts passing the sutures) is not yet at all understood. My specimens show the sharp, narrow emargination of the anterior margins of the first and second median abdominal blotches, which has been given as characteristic of *rufus* N. In size, however, the American specimens are distinct from any of the Old World members of the *fuscous* group. The female specimen I figure is from a Marsh Hawk, *Circus hudsonius*, and measures: Body, length 2.4 mm., width .62 mm.; head, length .6 mm., width .5 mm.

LIPEURUS.

***Lipeurus introductus* n. sp.** (Plate lxviii, figs. 1 and 5.)

Six females, two males, and an immature specimen from a Silver Pheasant, *Phasianus nycthemerus*, received by the Department of Zoology of this University from Mr. A. C. Robison of San Francisco. This Old World pheasant was introduced into America some years ago and it is now breeding wild in parts of the country. This *Lipeurus* species is of the type of *variabilis* N. (Giebel, *Insecta Epizoa*, p. 219, pl. xvi, fig. 3; Piaget, *Les Pediculines*, p. 364, pl. xxix, fig. 4; Denny, p. 164, pl. xv, fig. 6), showing the characteristic median abdominal blotches with concave sides and the striking sexual differences; but despite the fact that Piaget finds *variabilis* an extremely variable form and common to several pheasant hosts, I cannot fairly refer my specimens to this species, because of the much greater size, my specimens being one-third longer than the type forms of *variabilis*,

and because of numerous minor differences, such as the definite and characteristic number and arrangement of the long hairs of the metathorax, the presence of a hair on the temporal margins of the head, and the character of the genital blotch of the female.

Description of the female. Body, length 2.8 mm., width .66 mm.; colored and marked like *variabilis*; whitish, with distinct black lateral borders and chestnut median abdominal blotches concave on the sides.

Head, length .66 mm., width .5 mm.; in general like *variabilis*, but without ocular bands, or rather with large, subcircular ocular blotches in place of ocular bands (Giebel found merely "ein schwarzer Punkt" in *variabilis*); temporal margins not bare as in *variabilis*, but with a prickle behind the prominent eye, and a distinct hair and a prickle at the posterior angle.

Metathorax with a single long hair in the apex of the posterior angle, and just inside of this a white space with four long hairs (two in *variabilis*).

Abdomen not wholly bare except in angles, as Piaget's description of *variabilis* says, but with two longitudinal submedian rows of weak hairs, each in a small but distinct clear spot; the characteristic small triangular genital blotch of the female of *variabilis* is wanting, being replaced by a short, broad, oblong blotch which is united to the ventral segmental blotch preceding it, this segmental blotch being united also with the one preceding it.

Male. Body, length 2.5 mm., width .5 mm.; head, length .56 mm., width .4 mm.; with the strangely shaped head of *variabilis*, wider in front of the antennæ than across the temples; distinct black antennal bands, ocular blotches, and borders of posterior angles of temples running along posterior margin and terminating in a subcircular head; trabeculæ (wanting in female) peculiarly

slender, finger-like; the great antennæ with large first segment with slender blunt horn-like appendage nearer the base than tip; third segment also appendaged. Metathorax with an additional long pustulated hair on posterior margin on each side, just inside of white space bearing four long hairs. Brown median abdominal blotches broader than in female, separated from the black lateral bands by a narrow whitish space; the strongly chitinized genitalia extending through segments 5-8; broadest in segment 5, tapering in segments 6-7, and uniform, narrow, two-pointed in segment 8.

***Lipeurus snodgrassi* n. sp.** (Plate lxviii, fig. 2.)

A single female specimen of this strongly characterized *Lipeurus* from the Red-backed Rufous Hummingbird, *Trochilus rufous* (Palo Alto, California). This species resembles no other *Lipeurus* at all closely, though in the shape of the head and its peculiar length of forehead, in the short metathorax and heavy abdomen, there is suggested an affinity with *Lipeurus macrocephalus* Kellogg, taken from the Western Nighthawk, *Chordeiles virginianus henryi* (Palo Alto, California). See plate lxviii, fig. 3.

Description of female. Body, length 2.2 mm., width .56 mm.; whitish with sharp, black, rather broad lateral margins on head, thorax, and abdomen; abdomen with oblong, transverse, median, smoky brown blotches.

Head, length .55 mm., width .37 mm.; very long but not slender, and tapering but little; the forehead exceptionally long compared with hind head, the distance from antennæ to frontal margin being greater than from antennæ to occipital margin; front rounded, with lateral margins nearly parallel; suture obsolete; four short hairs on each side on the front or anterior part of lateral margin, and two short hairs in front of the short but distinct

uncolored trabeculæ; antennæ rather long, slender; segment 2 longest and very slender, especially at base, segment 3 slightly longer than segment 4, and segment 5 slightly longer than segment 3, segments 3-5 colored, with uncolored distal extremities; eyes small, but slightly produced, and with a hair; temporal margins very slightly convex, with two long hairs; occipital margin straight, bare; lateral margins of forehead and hind head bordered with black, widest on temples, and with uneven inner margin on forehead; the lateral borders of forehead pass the anterior lateral angles but do not run clear across the front, although a clear, slightly colored, even chitin band borders the entire clypeal front; mandibles and œsophageal sclerite distinct, dark brown, and an occipital signature acutely pointed anteriorly showing through from under side.

Prothorox short, quadrangular (that part not covered by the head), with rounding posterior angles and straight posterior margin; without hairs; whitish, with broad black lateral borders. Metathorax short, but little longer than prothorax, broader than long, with diverging sides which are slightly concave anteriorly, and straight, bare, posterior margin; the posterior angles with five long hairs in two groups of two and three, rising from white spaces, the group of two hairs really situated on the outer part of posterior margin; segment white, with broad lateral borders which are widest in posterior angles and extend inward, tapering along the posterior margin, not reaching the middle of the segment; metasternum with a brown median blotch; legs whitish, with distinct blackish border on femora and tibiæ, and annulations on femora; coxæ almost wholly colored, and tarsi brown.

Abdomen elongate, subparallel-sided, with a few longish hairs on dorsal surface; whitish, with sharply marked

lateral bands with short sharp irregular inward projecting processes; segment 3-6 with oblong, median, brown blotches, darker on segments 5-6 and not reaching the lateral bands; segment 8 with a narrow angulated or curving transversal black line connecting the lateral bands; segment 9 uncolored or whitish, angularly but not deeply emarginated.

Lipeurus macrocephalus n. sp. (Plate lxviii, fig. 3).

Many specimens taken from a Western Night Hawk, *Chordeiles virginianus henryi* (Palo Alto, Calif.). This species shows an affinity with *Lipeurus hypoleucus* N. (taken by Nitzsch in 1814 from *Caprimulgus europæus*, and first called by him *Nirmus concolor*, and then *N. hypoleucus*, under which name Giebel, *Insecta Epizoa*, p. 146, pl. viii, fig. 5, and Denny, *Monograph. Anoplur. Brit.*, p. 141, pl. vi, fig. 8, refer to it; and finally correctly removed by Piaget, *Supplement*, p. 66, pl. vii, fig. 3, to *Lipeurus*) by the general outline, the hairs of the head, and the character of the thoracic segments. The new species differ from *hypoleucus* distinctly, especially in the shape of the head and the character of the signature. Oddly enough Piaget was unable to find a male among his specimens, and among the twenty-seven specimens of the new species taken from the single individual of *Chordeiles* examined there is no male.

Description of female. Body, length 3 mm., width .66 mm.; fuscous, with dark rusty brown lateral bands on abdomen and thorax, and distinct occipital and antennal bands of head.

Head, length .65 mm., width .5 mm.; forehead as long as hind head, tapering but little and flatly convex, almost truncate in front; suture distinct, both at margins and behind signature; four short hairs in front of suture, the

one next to the most anterior being the longest; behind the suture two longer hairs; and rising from the base of the trabeculæ a long hair from the prominent eye, and two very long hairs and two prickles on the temporal margin; occipital margin flatly concave, nearly straight, bare; antennæ slender, all segments weakly colored, with uncolored tips; trabeculæ small but distinct, uncolored; brownish white, with signature and temples brown, and distinct occipital and interrupted antennal bands blackish brown; the signature is broad and short, obtusely angled behind, and shows a number of small whitish subcircular spots; internal bands (*i. e.* margins of the ventral furrow running anteriorly from the mouth) showing through faintly.

Prothorax quadrangular, a little broader than long, with slightly diverging sides, and straight, bare, posterior margin; no hair in posterior angles; ground color that of the head, with narrow uncolored median longitudinal line forking at anterior end; broad dark rusty brown lateral borders. Metathorax but little longer than prothorax, with diverging sides; lateral margins with a slight but distinct rounding concavity near anterior end; posterior margin straight; posterior angles with three longish hairs, and a group of two on posterior margin near the angle; these two and two of the three in angle pustulated; ground color of segment same as or slightly darker than prothorax, with uncolored median longitudinal line, and lateral irregular dark brown lateral borders, narrower than those of prothorax. Legs long, coxæ elongate, brown, with whitish distal ends; femora and tibiæ concolorous with pale ground color of thorax, with rusty brown marginal markings. Sternal markings composed of rather short, broad intercoxal lines between pro- and meso-legs, connecting with a short, narrow

transverse median blotch; on metasternum oblong intercoxal blotches, and a large median blotch longer than wide and pointed posteriorly.

Abdomen elongate, subparallel-sided; segments 1, 7 and 8 short; segment 9 very short; posterior angles of segments with a series of five longish fine hairs arising from very small but distinct pustulations near the posterior margin of each segment; beyond this series at each end and near the posterior margin a longer, stronger hair on larger pustulation; all segments except segment 9 with a broad chestnut brown transverse blotch covering all of the segment; stigmatal spots clear; narrow dark rusty brown lateral bands; sutures uncolored; segment 9 uncolored, with two faint brownish lateral blotches, weakly angularly concave behind, without hairs, except two very short prickles, one on each half of posterior margin,

Lipeurus baculus Nitzsch. (Plate lxviii, figs. 4 and 6.)

Germar's Mag. Entomol., 1818, vol. iii, p. 293.

Pulex columbæ majoris Redi, Opusculorum pars I, sive experimenta circa generationem Insectorum, 1686, pl. ii; Albin, Nat. Hist. Spiders and Other Curious Insects, 1736, pl. xliii.; Schrank, Enumeratio Insectorum Austriæ, 1781; Geoffrey, Hist. abrégée des Insectes, 1762, vol. ii, p. 599.

Pediculus columbæ Linne, Systema Natura, 1767; Fabricius, Systema Entomologiæ, 1775.

Nirmus filiformis Olfers, De Veg. et Anim. Corp., 1817, p. 90; Lyonnet, Rech. s. l'anat. et les met. d. diff. esp. d. insectes, 1832, p. 273, pl. xiii, fig. 10.

Lipeurus baculus. Nitzsch, Burmeister, Handbuch d. Entomologie, 1832, vol. ii, p. 434; Denny, Monograph. Anoplur. Brit., 1842, p. 172, pl. xiv, fig. 3; Gurlt, in Mag. f. d. ges. Thierheilk, vol. viii, p. 424, pl. viii, fig.; Nitzsch (ed. Giebel) Zeitschr. f. ges. Naturwiss, 1866, vol. xxviii, p. 379; Giebel, Insecta Epizoa, 1874, p. 216; Piaget, Les Pediculines, 1880, p. 303, pl. xxv, fig. 2; Taschenberg, Die Mallophagen, 1882, p. 123; Giraud, Bull. de la Soc. Ent., 1859, p. 140; Osborn, the Pediculi and Mallophaga affecting man and the lower animals, Bull. No. 7, Div. of Ent., U. S. Dept. of Agric., 1891, p. 38, with fig.

Lipeurus bacillus Nitzsch (ed. Giebel) Zeit. f. ges. Naturwiss., 1861, vol. xviii, p. 305; Giebel, Insecta Epizoa, 1874, p. 215, pl. xvi, figs. 8, 9; pl. xx, fig. 3.

Lipeurus antennatus Giebel, Insecta Epizoa, 1874, p. 213.

Lipeurus angustus Rudow, Zeitschr. f. ges. Naturwiss., 1870, vol. xxxvi, p. 137.

Specimens of this long known parasite of doves and pigeons taken from a domestic pigeon, *Columba livia*. I follow Piaget and Taschenberg in their refusal to recognize as species the numerous variants observed. The definition of this species presents a case similar to that presented by *Lipeurus squalidus* (see discussion of *squalidus*).

I figure the female and head of male, not alone for the convenience of American students, but because the previously published figures of this species are faulty. Piaget figures the male. Osborn's figure, undoubtedly well drawn, is spoiled in the printing. Piaget is in error in attempting to correct Giebel's statement that there are four small clavate appendages on the frontal part of the clypeus. Piaget declares there are but two such appendages; in my specimens there are distinctly four. The female specimen figured by me measures: body, length 2.5 mm., width .37 mm.; head, length .42 mm., width .28 mm.

***Lipeurus dissimilis* Piaget.** (Plate lxviii, fig. 7.)

Les Pediculines, 1880, p. 359, pl. xxix, fig. 1.

Two specimens, one immature, from a Bob-white *Colinus virginianus* (Lawrence, Kansas). Piaget described the species from specimens taken from the same bird species in the Zoological Garden of Rotterdam. My specimens differ from Piaget's description in some particulars. Piaget says, "l'œil nu;" my specimens have a distinct longish hair in the eye; the lateral bands

of the abdomen distinctly pass the suture in my mature specimen; Piaget says that the bands do not pass the sutures.

The species may be recognized by its general similarity in form and appearance to *Lipeurus docophoroides* Piaget, of the California Quail (see pl. lxviii, fig. 8). *Dissimilis* differs from *docophoroides* in having the head more rounded in front, the abdomen longer and broader, and in the absence of pustulations at the bases of the hairs. My specimen (mature) measures: Body, length 2.4 mm., width 1.03 mm.; head, length .6 mm., width .53 mm.

***Lipeurus docophoroides* Piaget.** (Plate lxviii, fig. 8.)

Les Pediculines, 1880, p. 357, pl. xxviii, fig. 9.

Two female specimens of this striking *Lipeurus*, taken from a California Partridge, *Callipepla californica* (Mountain View, California). Piaget found his specimens on individuals of the same bird species in the Zoological Garden of Rotterdam. The species is a transition form between *Docophorus* and *Lipeurus*. Piaget says of it: "La forme du thorax, des pattes en général et de l'abdomen, la présence des trabécules indiquent une transition au genre *Docophorus*; l'antenne, la fossette, l'implantation du coxis au bord du thorax, l'étranglement du métathorax, la forme du dernier segment ♂ attachent cette espèce aux *Lipeuri*."

The species may be recognized by its pointed conical head, with black and dark brown bands and markings, by its Docophoroid body, with distinct black lateral bands on thorax and abdomen, and by its whitish ground color and dark chestnut brown transverse lateral blotches, with pustulated hairs and large uncolored stigmal areas. The specimen figured by me measures: Body, length 1.93 mm., width .78 mm.; head, length .56 mm., width .51 mm.

GONIODES.

Goniodes cervinicornis Giebel. (Plate lxix, fig. 1.)

Insecta Epizoa, 1874, p. 199.

Goniodes cervinicornis G., Piaget, Les Pediculines, 1880, p. 272, pl. xxii, fig. 6.

Numerous specimens from a Silver Pheasant, *Phasianus nycthemerus*, sent to the Department of Zoology of this University by Mr. A. C. Robison of San Francisco, Calif. This large and striking *Goniodes* of the pheasants (Giebel's specimens were found by Kollar on *Phasianus nycthemerus*, and Piaget has found it abundantly on *Tragopan satyrus*) is characterized by the peculiar bipartite appendage on the first segment of the antenna of the male. It may be readily recognized by comparison with the figure of the female which I give. My specimens measure; Male: Body, length 3.34 mm., width 2 mm.; head, length .9 mm., width 1.32 mm. Female: Body, length 3.75 mm., width 2. mm.; head, length 1.03 mm., width 1.34 mm. These measurements are markedly greater than those given by Piaget; his male specimens averaging 2.75 mm. long, and the females 3.1 mm. long.

Goniodes mammillatus Rudow. (Plate lxix, fig. 2.)

Zeitsch. f. d. ges. Naturwiss., 1870, vol. xxxv, p. 483.

Goniodes mammillatus Rudow, Taschenberg, Die Mallophagen, 1882, p. 25, pl. i, figs. 1, 1a, 1b.

Two females from a California Partridge, *Callipepla californica* (Mountain View, California). This striking species was first described by Rudow from a specimen taken from *Pelecanus ruficollis*! (a dried skin in some museum). Taschenberg, who collected a number of specimens from *Callipepla californica* (skins?), says: "Wenn die Art wirklick wie Rudow angiebt, auf *Pelecanus ruficollis* angetroffen ist, so ist es in Folge zufälliger

Uebertragung geschehen." The species may be recognized by the broad abdomen and the striking angulated lateral bands of the abdomen, each segmental portion projecting diagonally forward and inward and ending in an indistinctly limited paling brown blotch. Taschenberg says that the head of the male is a little longer than broad, with deep emarginations at the bases of the antennæ, and with strongly angulated temporal margins between which the head is a little narrower than it is just in front of the antennæ. The female figured by me measures as follows: Body, length 2.25 mm., width 1.16 mm.; head, length .62 mm., width .72 mm.

GONIOCOTES.

Goniocotes creber n. sp. (Plate lxix, fig. 3.)

An extraordinary number of specimens on a Silver Pheasant, *Phasianus nycthemerus*, presented to the Department of Zoology of this University, by Mr. A. C. Robison of San Francisco. In addition to the great number of individuals of this *Gonioeotes* on the bird, there were present in more than ordinary numbers the giant *Goniodes cerviniornis*, *Lipeurus introductus* n. sp. and *Menopon monostæhum* n. sp. The short feathers of the neck, especially of the throat, were literally covered with the eggs of some one of these species. This *Gonioeotes* resembles in general characters Giebel's species *chrysocephalus* (Insecta Epizoa, p. 189), a common *Gonioeotes* of Pheasants, found so far on *Phasianus colchicus*, *nycthemerus*, *sommerringii*, *pietus*, and *Euplocamus ignitus*, but is a markedly larger species.

Description of the female. Body, length 1.6 mm., width .87 mm.; pale yellowish brown, with darker head and with dark brown head markings, and lighter lateral bands which are peculiarly curved so as to enclose a less chitinized space.

Head, length .44 mm., width .6 mm.; front broad, convex, with ten short prickles; antennæ in a shallow emargination with second segment longest and the fifth longer than third or fourth, which are about equal; eye prominent, with a prickle; the slightly protruding, rounded temporal margins with a prickle and two strong hairs; posterior margin concave in middle, with obtuse angles at each end of the concavity; head brownish, with darker narrow marginal frontal bands ending posteriorly on each side in an expanded darker spot inside of antennal emargination; mandibles and œsophageal sclerite dark brown; an irregular brown ocular blotch and a sinuous dark brown occipital border along the concave curve of the occipital margin.

Prothorax very narrow, short, trapezodial, with lateral margins converging anteriorly, and posterior margins flatly convex; the latero-posterior angles are slightly produced and acute, and each bears a strong hair; indistinct brownish lateral borders. Metathorax with blunt lateral angles, each with two strong hairs; posterior margin obtusely angled on abdomen, and bare except for two hairs near the lateral angles. Legs concolorous with body, with dorsal marginal markings and some scattered spines.

Abdomen broadly elliptical; posterior angles of segments projecting and bearing, except on segment 1, one to three rather short, strong, finely pointed hairs; segment 1 longest at sides but short in middle because of the backward projecting angulated thorax; middle region of abdomen pale to uncolored, faint lateral transverse blotches and conspicuous lateral bands, which on all segments except segment 1 are curved so as to enclose a small uncolored space; the curved band projects inward and forward, passing the suture; the last segment

flatly rounded behind, with a slight angular emargination, the margin bordered by a narrow uncolored space.

Male. Body, length 1.15 mm.; width .7 mm.; head, length .34 mm., width .47 mm.; abdomen as wide as long, suborbicular; median uncolored region of abdomen relatively larger than in female; lateral transverse blotches no more distinct than in female, but lateral bands more strongly chitinized; posterior margin of abdomen broad, straight, with projecting rounded ninth segment in the middle; posterior border of ninth segment colored, the margin with a few short strong hairs; genitalia extending far forward.

Goniocotes compar Nitzsch. (Plate lxix, fig. 4.)

Germer's Mag. Entomol., 1818, vol. iii, p. 294.

Pediculus bidentatus (?) Scopoli, Ent. Carn., 1763, p. 385.

Philopterus compar Nitzsch, Walckenaer, Hist. Nat. Ins. Apt., 1844, vol. iii, p. 358.

Goniocotes compar Nitzsch, Burmeister, Handbuch d. Ent., 1835, p. 431; Gurit, Mag. f. d. ges. Thier., 1842, vol. viii, p. 117, pl. iv, fig. 2; Denny, Monograph. Anoplur. Brit., 1842, p. 151, pl. xiii, fig. 2; Giebel, Zeitsch. f. ges. Nat., 1861, vol. xviii, p. 305; l. c., 1866, vol. xxviii, p. 389; Giebel, Insecta Epizoa, 1874, p. 183, pl. xii, fig. 8; Piaget, Les Pediculines, 1880, p. 284, pl. xix, fig. 10; Taschenberg, Die Mallophagen, 1882, p. 69; Osborn, The Pediculi and Mallophaga Affecting Man and the Lower Animals, 1891, Bull. 7, Div. of Ent., U. S. Dept. Agri., p. 33, fig. 19.

Specimens taken from a Domestic Pigeon, *Columba livia* (Lawrence, Kansas). This well known *Goniocotes* of the Domestic Pigeon has been found by Piaget on *Columba palumbus* and *C. phasianella*, and by Denny on *Columbus oenas*, *C. palumba* and (a variety, Denny thinks) on *C. turtur*, as well as on the various races of the domestic pigeon. It is a small form, only about 1 mm. long, whitish, with a pale brownish border along the lateral margins of the abdomen and thorax; the temples are angled and bear two very long backward-projecting

hairs. The posterior margin of the metathorax is angulated and the angle projects so far backward that it nearly cuts the first abdominal segment in two. Professor Osborn's figure is faulty in representing the metathorax with straight posterior margin. The male figured by me measures: Body, length 1.06 mm., width .48 mm.; head, length .34 mm., width .37 mm.

PHYSOSTOMUM.

Physostomum microcephalum n. sp. (Plate lxx, fig. 1.)

A single female from the House Finch, *Carpodacus mexicanus frontalis* (Palo Alto, California). Not common on its host, as I have a record of twelve other individuals of *Carpodacus* from which Mallophaga were taken, but on none of them was this *Physostomum* again found. The new species approaches the general type of *P. agouini* N. (Giebel, *Insecta Epizoa*, p. 255), from *Sylvia rubecula* and *S. suecia* more nearly than it approaches any other of the Old World species.

Description of female. Body, length 3.6 mm., width 1.25 mm.; head small; abdomen large and exceptionally broad; head markings pale, ill-defined; distinct brown lateral bands; paler colored large median transverse abdominal blotches.

Head, length .66 mm., width .72 mm., thus being wider than long, which is exceptional in *Physostomum*, and being especially small in proportion to the size of the whole body; front flatly rounded, and sides of forehead weakly concave; prickles on front, one hair on margin at extremity of transverse clypeal suture, and a few very short hairs and two longer ones along margin before the eye; eye distinct, with a black fleck; palpi passing the margins of head; the blunt lateral flaps slightly passing the margin; temples not produced very far backward, with a little

narrowed tip at the apex of the posterior angle; temporal margins with three longish hairs and a few short ones; markings weakly colored, a pale chestnut brown.

Prothorax, with distinct lateral angles, in apex of which a spine and a long hair; another long hair near rounded posterior angle, and two spines on margin in front of lateral angle; segment whitish, with faint brownish tinges on lateral borders and elsewhere. Metathorax with weak concavity on lateral margins in front of the middle; two hairs in the posterior angles, and some scattered short spines on margin and dorsal surface of anterior half (mesothorax) of segment; color of prothorax, with brown lateral borders narrowing anteriorly. Legs concolorous with thorax, with narrow darker marginal color.

Abdomen large, expanding in the middle half, and broad and bluntly rounded behind; not very long single hairs in the posterior angles, and on the dorsal surface just inside of the colored lateral bands a double longitudinal row of weak hairs; whitish, with distinct brown lateral bands and large oblong median abdominal blotches, darkest on segments 5 and 6.

Physostomum sucinaceum n. sp. (Plate lxx, fig. 2.)

Three females from a Western Flycatcher, *Empidonax difficilis* (Palo Alto, California). A small *Physostomum*, the smallest I have taken.

Description of female. Body, length 2.84 mm., width .81 mm.; ground color pale amber instead of whitish, as is usual with *Physostomum*; brownish lateral bands, and head markings not strongly colored.

Head, length .53 mm., width .5 mm.; front rounded, with usual few hairs; palpi short, barely passing the margins of head; temples produced backwards and acutely angled with three longish hairs and some short ones;

clypeus clear, almost uncolored; head markings dark brown, but not very sharp; eye with black fleck.

Prothorax with almost no lateral angles, the angles being very obtuse and flattened; two spines and a long hair in the angles and another long hair near the posterior angle; posterior margin of segment concave; a brownish submarginal lateral border. Metathorax with a few small spines along lateral margins, and a longish hair near posterior angles. Legs whitish, paler than body color.

Abdomen with sides only flatly convex, subparallel; single hairs on posterior angles of segments and a longitudinal row of small hairs, one on each segment, on each side inside of the lateral band; lateral bands pale amber brown, not much darker than ground color of body; faint median transverse blotches, apparently nearly square.

Physostomum angulatum n. sp. (Plate lxx, fig. 5.)

Two females taken from a Kingbird, *Tyrannus tyrannus* (Lawrence, Kansas), and one female from a Fox Sparrow, *Passerella iliaca* (Lawrence, Kansas).

Description of female. Body, length 5. mm., width 1.3 mm.; pale golden, with narrow dark brown lateral bands on abdomen and thorax, and few dark brown head markings; the largest *Physostomum* yet found.

Head, length 1 mm., width .94 mm.; front flatly convex, without marginal hairs, sides with two short hairs on dorsal surface near and projecting over the margin even with base of antennæ, and at same place two similar submarginal ventral hairs, and two shorter hairs on margin in the very slight ocular emargination; occipital angles acute and much produced posteriorly (extending nearly to middle of prothorax), bearing three long hairs; occipital margin is thus very concave and is without hairs; palpi projecting beyond margin by half of last segment;

labral lobes inconspicuous, not projecting beyond margin of head; a distinct, curved, dark brown blotch bounding inner margin of antennal fossa; in front of it two paler blotches, the anterior being the larger, and a narrow dark brown occipital border; the rest of head concolorous with the body or paler.

Prothorax hexagonal, the angles rounded, the lateral angles with a longish weak hair and a spine; a distinct, brown, submarginal border laterally, which turns inward at its anterior end and is looped. Metathorax longer than prothorax, with gently sinuous sides, without distinct marginal hairs (a short projecting hair or spine near the posterior angle is not strictly marginal); posterior margin straight; anterior angles with irregular brown blotch, a linear, diagonal blotch on each side near middle, and submarginal lateral bands continuous with those of the abdomen. Legs long, slender, concolorous with the body.

Abdomen elongate-elliptical, truncate anteriorly, with sharply marked dark brown to black submarginal lateral bands composed of segmental parts separated by diagonal sutures and slightly laterally displaced; posterior angles of segments with one or two weak hairs; vulva convex.

Physostomum australe n. sp. (Plate lxx, fig. 4.)

One female from a Western Nonpareil, *Passerina versicolor* (Cameron County, Texas), resembling *angulatum* in marking but smaller and head comparatively shorter and narrower anteriorly, hence more tapering; with abdomen with median blotches which are wanting in *angulatum*.

Description of female. Body, length 4 mm., width 1.06 mm.; almost uncolored, with yellowish tinge strongest on head and thorax; with sharp black lateral markings and pale brown median abdominal blotches.

Head, length .68 mm., width .7 mm.; front narrow, flatly convex, without hairs; sides with a distinct rounding emargination even with the mouth parts; ocular emargination filled by the conspicuous eye; occipital angles not so acute as in *angulatum*, but projecting backwards nearly to lateral angles of prothorax, and with three longish hairs. Markings similar in position to those of *angulatum* but more pronounced; antennal fossa entirely rimmed and connected with occipital border by a short occipital band; in front of the antennal fossa three blotches (instead of two as in *angulatum*), the most anterior being a short band projecting inward from the lateral margin.

Prothorax with the constriction in front of lateral angles especially marked and the angles with one or two spines but no hair; general color of the segment golden brown, with black submarginal lateral bands. Metathorax with a rounded swelling on anterior third of sides, without marginal hairs and with markings resembling those of *angulatum*, viz., irregular black blotches in anterior angles, submarginal lateral bands continuous with those of abdomen, and two short linear blotches lying inside of the lateral bands which are in this species entirely disconnected from the bands and are but slightly diagonal. Legs pale with distinct narrow black margins on femora and indistinct narrower tibial margins.

Abdomen; segments with one long hair on lateral margin near posterior angle; posterior margin of last segment with hairs composing the delicate fringe unusually long; uncolored to pale golden, with uniform submarginal lateral black bands (more nearly continuous than in *angulatum*, the diagonal sutures and lateral displacement of the various segmental portions being less marked);

on segments 1-7 a pale brown median blotch, the blotches on segments 4-5 being larger; vulva convex.

Physostomum diffusum n. sp. (Plate lxx, fig. 3.)

One female taken on the Sandwich Sparrow, *Passerculus sandvicensis*, and several males and females taken on the Golden Crown Sparrow, *Zonotrichia coronata* (near Stanford University, Calif.); also two females and a young specimen (variety *pallidum* Kellogg) from a *Junco* sp. (Lawrence, Kansas). This species differs from the preceding two species described in having the lateral abdominal bands distinctly marginal (as is the case with the species of Piaget, Nitzsch, and Denny), and in this it resembles the European species. It has the very long, backward-projecting, occipital angles, as in *angulatum* and *australe*, which is a character shown by but few of the European forms.

Description of female. Body, length 4 mm., width 1.09 mm.; white, with dark brown to black marginal lateral bands on abdomen and thorax, and few black head-markings; the labral lobes large and projecting.

Head, length .8 mm., width .7 mm.; front rather broad, flatly convex, without marginal hairs, sides nearly straight but slightly constricted even with the projecting labral lobes; a single projecting submarginal hair near middle of head, with a very short hair barely reaching margin close to it; in the small ocular emargination several short hairs; occipital angles acute, with two long hairs; the palpi barely project beyond the lateral margin of the head but the labral lobes are large and project conspicuously beyond the margin; markings consisting of a small black ocular fleck, a dark brown blotch on inner margin of antennal fossa, and in front of it two smaller blotches, the anterior the least distinct; a narrow, interrupted,

smoky, occipital margin, indications of occipital bands, and a narrow, indistinct smoky margining of the temples.

Prothorax hexagonal, with anterior and posterior margins weakly concave; in the obtuse lateral angles a hair and two spines; segment white with a narrow submarginal black band, the margin outside of it being more or less suffused with smoky brown. Metathorax with a slight lateral swelling on the lateral margin near the anterior end, bearing a few short pale brown spines; in the posterior angles a single, longish, weak hair; segment white, with a narrow, submarginal, lateral band, outside of which on posterior half of segment the margin is smoky brown. Sternal markings consisting of an intercoxal line, long and curving forward, on metasternum, and two faint median lines on prosternum. Legs, white.

Abdomen. Posterior angles with a single longish hair and a shorter weaker one on lateral margin of each segment of segments 5-8; last segment flatly rounded with two pairs of hairs, and the posterior fringe distinct; dorsal surface without hairs, or with very few; segments white, with broad, black, marginal, lateral bands fading out on eighth segment; indications of narrow, transverse, linear, median blotches at the sutures; under side of abdomen with pale brown, median blotches on segments 5-6.

Var. *pallidum* Kellogg. Two females and a young specimen taken from a *Junco* sp. (Lawrence, Kansas) may be referred to this species but they show varietal differences. The body color is pale golden, the markings are brown, not black, and the middle region of the whole abdomen is pale brownish; of the head markings only the ocular fleck and the bounding blotch on inner rim of the antennal fossa are distinct.

COLPOCEPHALUM.

Colpocephalum chrysophæum n. sp. (Plate lxxi, fig. 1.)

Found on three out of seven specimens of Samuels' Long Sparrow, *Melospiza fasciata samuelis* (Palo Alto, California).

Description of female. Body, length 1.35 mm., width .7 mm.; golden brown with blackish brown bands and margins, and rusty brown transverse blotches.

Head, length .28 mm., width .5 mm.; broadly parabolic in front; one short hair on each side of the middle, then a longer one, then a short one, then a very long one, then two longish ones; the palpi project by at least the last two segments; the ocular emargination is distinct but not acute inwardly; the eye is large, emarginate, and with a distinct black fleck; ocular fringe distinct; temples projecting, rounded, rather narrow, with several long hairs of different lengths, of which two are very long and equal; on the occipital margin of the temples another very long hair and two or three shorter ones; middle part of occipital margin with a few long hairs; head tinged with fuscus with black, curving, broadly linear, ocular blotch and narrow curving transversal black line subparallel with frontal margin of clypeus; occipital and inner bands forming a brownish H in middle of head, the lines being broad and slightly curving; in the anterior part of the H a brown blotch, and a tapering brown triangle projecting backward from the cross bar of the H; four small pale to uncolored circular spots, one at each end of the cross bar of the H, and the two others outside of but contiguous to the anterior legs of the H.

Prothorax broad, short, with a strong hair in the lateral angles and two spines, and ten longish hairs ranged along the posterior margin; the transverse chitinized bar is

especially narrow and distinct, and the curving longitudinal lines beyond the ends are sharply defined and black. Metathorax with posterior margin straight and with about ten longish weak hairs ranged along it; darkest along the short anterior margin and in the latero-posterior angles. Legs pale, with sharply defined marginal markings, especially on the coxæ and on the long slender tibiæ of middle and hind legs. Sternal markings consisting of a small median triangle with linear wings on prothorax, and of black, distinct, angulated, intercoxal lines between meso- and meta-coxæ.

Abdomen ovate, broad at both ends; long hairs in posterior angles of segments, and short hairs, not numerous, on dorsal surface; all segments with a broad, brown, transverse blotch extending entirely across segment, covering almost the whole surface; the sutures, however, are broad and uncolored; lateral bands narrow, black, fading inwardly into the transverse blotches; last segment broad, flatly convex behind, with a fringe of short hairs.

Male. Body, length 1.09 mm., width .5 mm.; head, length .25 mm., width .4 mm.; conspicuously smaller than the female; genitalia extending through segments 5-9, in shape a heavy two-pronged fork.

Colpocephalum osborni n. sp. (Plate lxxi, figs. 2 and 3).

Many specimens, males, females and young, from a White-tailed Kite, *Elanus glaucus* (Palo Alto, California), resembling *C. dissimile* Piaget (Les Pediculines, p. 520, pl. xliii, fig. 4), taken from *Milvus ægyptius* (Museum of Leyden), and *C. trilineatum* Nitzsch (Giebel, Insecta Epizoa, p. 263), taken from *Milvus ater*. Named for Prof. Herbert Osborn of Iowa, who has contributed to the knowledge of American Mallophaga.

Description of male. Body, length 1.31 mm., width

.5 mm.; golden brown, with distinct, broad, black, occipital bands with expanded extremities, and dark brown, transverse, abdominal blotches with black lateral ends.

Head, length .31 mm., width .5 mm.; rather large compared with whole body, just as wide as widest part of abdomen; front broad, flatly rounded, with seven hairs on each side of the median line, four of which are grouped together in front of the ocular emargination; last segment of antenna broad, with slightly concave terminal margin projecting beyond margin of head; ocular emargination pronounced, the deepest point being acutely angled; an ocular fringe; swelling rounded temporal margins, with several hairs of different lengths, three being about equal and longest; occipital margin concave, with four hairs; golden brown, with large black subcircular ocular blotches and triangular occipital blotches connected by the broad, paler (reddish brown) occipital bands; the occipital blotches connected by an even, strongly colored, broad, occipital border; clypeus with two blackish brown blotches connected with the ocular blotches and mandibles by colored areas but little darker than the ground color of head.

Prothorax short, extending laterally even with the outer margin of the occipital blotches of the head, with a hair and spine in each lateral angle, and eight hairs along the flatly convex posterior margin; concolorous with ground color of head. Metathorax short, with flatly convex posterior margin, bearing a series of short, weak hairs; a transverse chestnut-brown blotch across posterior half of segment, expanding and darker at lateral ends. Legs with distinct dark brown markings.

Abdomen bluntly elliptical, third segment widest, with segments projecting but little laterally; many short hairs along sides and on dorsal surface; segments 1-8 with

broad, transverse, dark chestnut-brown blotch entirely across segment, darkest laterally, with sharp black angulated lateral bands, especially noticeable on segments 3-8; last segment without noticeable blotch, bluntly rounded behind, without numerous hairs.

Female. Body, length 1.47 mm., width .63 mm.; head, length .3 mm., width .5 mm.; with abdomen obovate, tapering posteriorly; abdominal blotches darker laterally but paler in the middle; lateral bands not angulated and wider; last abdominal segment elongate, tapering, with narrow flatly convex posterior margin; segment 8 with a group of seven strong curving hooklike hairs, the posterior ones longest, situated on posterior part of lateral margin of segments; posterior margin of this segment with a series of closely set hairs.

Colpocephalum fumidum n. sp. (Plate lxxi, fig. 5.)

A single specimen from a Least Bushtit, *Psaltiriparus minimus* (Palo Alto, California). A strikingly dark *Colpocephalum* showing resemblance to some of the *Colpocephali* of the water birds, such as *uniseriatis* Piaget (Les Pediculines, p. 562, pl. xlvii, fig. 2), from an Avocet, *Recurvirostra avocetta*, rather than to any of the few *Colpocephali* hitherto described from passerine birds.

Description of female. Body, length 2.75 mm., width 1.1 mm.; very dark, smoky, with black occipital margin, ocular blotches, and blackish lateral abdominal bands.

Head, length .5 mm., width .75 mm.; forehead large, flatly rounded in front, with numerous short hairs; two longer hairs in angle in front of ocular emargination; the ocular emargination pronounced, angulated, with the anterior margin of the produced temples almost at right angles to the long axis of the head; the eye prominent, almost if not quite divided, the anterior and larger part

lying in the angle of the emargination, the smaller and posterior part lying apparently on the dorsal surface of the temple; ocular fringe distinct, composed of longish hairs; temporal margins with slightly rounded anterior and posterior angles, and slightly convex lateral margin which bears five longish hairs; occipital margin weakly sinuous and concave, with four hairs; fuliginous with black uneven occipital border; small black ocular blotches, and four small circular uncolored spots on forehead, from each of which arise one or more hairs.

Prothorax with bluntly rounded lateral angles, slightly concave latero-posterior margins, and convex posterior margin, the segment produced backward so as to very materially narrow the median part of the mesothorax, with a spine and a long hair in the lateral angles and two separated hairs on the concave lateral margins, the anterior hair being short and weak. Mesothorax separated from metathorax by an uncolored suture, but with extremely slight lateral emargination; no hairs. Metathorax larger than mesothorax, with straight posterior margin, a spine, a weak hair and a strong hair in posterior angles, and posterior margin not with a marginal series of hairs; all the thoracic segments very dark, the ground color same as that of head and darker than that of abdomen; the lateral borders darkest. Legs concolorous with body, robust.

Abdomen long-ovate, segments of equal lengths, a few long hairs in posterior angles, and dorsal surface with posterior margins of segments with single series of hairs set in faint pustulations; ventral surface with series of short fine hairs in small but distinct pustulations; last segment narrowly, flatly convex, with a fringe of fine uncolored hairs; whole abdomen smoky but lighter than head and thorax; black lateral bands paling inwardly.

Colpocephalum flavescens Nitzsch. (Plate lxxi, fig. 4.)

German's Mag. Entomol., 1818, vol. iii, p. 298.

Colpocephalum flavescens N., Nitzsch (ed. Giebel) Zeitschr. f. ges. Naturwiss., 1861, vol. xvii, p. 522; Burmeister, Handb. d. Ent., 1835, vol. ii, p. 438; Denny, Monograph., Anoplur. Brit., 1842, p. 206, pl. xviii, fig. 2; Giebel, Insecta Epizoa, 1874, p. 262, pl. xiii, fig. 10; Piaget, Les Pediculines, 1880, p. 515, pl. xlii, fig. 10.

Specimens which should probably be referred to this species from two Bald Eagles, *Haliaeetus leucocephalus*, and an American Rough-legged Hawk, *Archibuteo lagopus sancti-johannis* (Lawrence, Kansas). The male figured by me measures: Body, length, 1.5 mm., width, .6 mm.; head, length .31 mm., width .53 mm. The species may be recognized by the strong distinct blotches and occipital bands and border of the head, and the transversal abdominal blotches.

Colpocephalum subæquale Nitzsch. (Plate lxxii, fig. 1.)

German's Mag. Entomol., 1818, vol. iii, p. 299.

Colpocephalum subæquale N., Burmeister, Handb. d. Ent., 1835, vol. ii, p. 438; Giebel, Insecta Epizoa, 1874, p. 265, pl. xiii, figs. 13 and 14, Piaget, Les Pediculines, 1880, p. 527.

Two females from an American Crow, *Corvus americanus* (Palo Alto, California). I did not find this species represented on several other crows shot at Palo Alto and at Lawrence, Kansas, although all of the individuals were infested by other parasites, such as *Docophorus atratus* or *Menopon mesoleucum*. My specimens do not have the dorsal surface of the thoracic segments with scattered long hairs, nor the surface of the abdomen thickly beset with hairs, as Giebel's description (Insecta Epizoa, p. 265) records; but neither are these hairs shown in Nitzsch's figure. Nitzsch's specimens were found on *Corvus corax* and *C. frugilegus*. My specimens do not have the first two segments of the abdomen especially lengthened as in Rudow's *semicinatum* (Zeitschr. f.

ges. Naturwiss., 1869, vol. xxxiv, p. 394), from *Corvus scapulatus*. The species may be recognized by the broad black occipital border and occipital bands, ocular and frontal blotches of the head, and by the transverse abdominal blotches of the abdomen, much narrowed in the middle in the male, and divided in the female into a median and two lateral parts. The female figured by me measures: Body, length 1.53 mm., width .63 mm.; head, length .31 mm., width .5 mm.

Menopon decoratum n. sp. (Plate lxxii, fig. 2.)

One male, one female, and a young specimen from a White-tailed Kite, *Elanus leucurus* (Palo Alto, California). A finely marked species not resembling especially any other *Menopon* hitherto taken from birds of prey. No *Menopon* has heretofore been taken from a Kite.

Description of male. Body, length 1.53 mm., width .72 mm.; pale yellowish brown, with dark rusty brown to black markings; distinct transverse bars on abdominal segments, the one on segment 2 especially strongly defined.

Head, length .31 mm., width .66 mm.; robust, more than twice as wide as long; front broad, flatly rounded, with a few short weak hairs, and on the weak swelling in front of the shallow ocular emargination two strong hairs, of which one rises from the dorsal surface; temples expanded, with two longish hairs and three very long ones; occipital margin concave, straight in the middle, with four long hairs; large black ocular fleck; an irregular blackish brown ocular blotch (on base of antennal band), the two connected by a paler curving transverse band, and also connected with the occipital margin by pale, broad, ill-defined occipital bands, the bases of the bands being blackish brown; on the forehead in front of mandibles a pale, short, curving band on each side.

Prothorax irregularly hexagonal, with obtuse lateral angles, and posterior margin flatly convex, with a very obtuse median angle; lateral angles with one very long hair and one shorter one, and a series of eight strong hairs along posterior margin, the terminal hair at each end of the series being exactly in the latero-posterior angle; chitinized transverse bar in anterior part of segment is weakly colored, and the longitudinal bars at its end are indistinct. Metathorax as short as or slightly shorter than prothorax, wider, with posterior margin straight; two long hairs in posterior angles, and a series of shorter weak ones along posterior margin; anterior angles with strongly colored blotch; an ill-defined, short longitudinal blotch projecting back from converging lateral margins. Legs palely colored.

Abdomen broadly ovate, wide and flat behind; posterior angles of segments with two usually long hairs and several short ones; single series of hairs not numerous on dorsal surface; lateral bands blackish brown, broad, interrupted, the segmental portions projecting inward; dark chestnut brown transverse blotches across the segments, with the pale or uncolored sutural bands broad; the colored transverse band of segment 2 is specially strongly marked, and is rather sinuous; last segment with broad, uncolored, posterior border, and with posterior margin straight, with a slight median emargination, and a sparse fringe of hairs of different lengths.

Female. Body, length 2. mm., width .94 mm.; head, length .4 mm., width .7 mm.; perhaps a little darker; the transverse blotches of abdomen better defined; last abdominal segment narrower than in male, and the posterior margin broadly parabolic, with few long, and numerous short hairs.

Menopon robustum n. sp. (Plate lxxii, fig. 3.)

A single specimen found on a Least Bush Tit, *Psaltriparus minimus* (Palo Alto, Calif.). No other specimens of this strange species were found on five other individuals of the same bird species examined. I refer the species to the genus *Menopon*, for it is evidently more closely allied to this genus than to any other one so far established. But it presents a mingling of characters of *Menopon*, *Ancistrona* and *Eureum*; a short broad head with strongly chitinized backward-projecting processes on the ventral surface like *Ancistrona*; a thorax like *Eureum*, and the habitus and general body characters of *Menopon*. If it is to be referred to *Menopon* it ranks with *titan* and *tridens* as anomalous members of the genus, which should be distinguished by subgeneric names, or which should be the provocation for breaking up the already unwieldy genus into several genera. In general shape it resembles *M. subrotundum*, Piaget (Les Pediculines, p. 453, pl. xxxv, fig. 2), from *Gracula sulcirostris*.

Description of the female. Body, length 1.43 mm., width .85 mm.; being thus very broad and short; smoky translucent brown, with broad, transverse, abdominal bands, darker on the lateral margins; head with no well defined bands or blotches except the small ocular flecks: labial projections of under side showing through; head with very long hairs.

Head, length .25 mm., width .6 mm.; very broad and short, crescentic, with narrow rounded ends; front with one very short hair on each side of middle, then two short ones and then three long hairs, the hindmost two being in the lateral angle just in front of the ocular emargination; palpi short, not reaching the margin; the emargination small but distinct, with the eye large, nearly

divided, and with a distinct fleck; the narrow produced temples with five long hairs of which the hindmost three are very long; occipital margin with six hairs, the two outer ones arising submarginally, no distinct head bands or blotches; the occipital margin narrowly bordered with black; on the under side of the head there are two strongly chitinized, backward-projecting, pointed processes arising from the labium (resembling those, but not bipartite, of *Ancistrona*); these processes show through above and give an appearance of faint occipital bands.

Prothorax very large, as long as the head, and three-fourths as broad, with strong, produced, obtuse, lateral angles; posterior margin obtusely angled on the metathorax; a strong spine and a long hair in each lateral angle, and a not well filled series of weak hairs along posterior margin; the transverse chitin bar distinct, blackish brown, and the curving longitudinal chitin bars at its ends distinct, blackish; no well defined blotches. Metathorax with a few small spines along lateral margins and two longish hairs in posterior angles; posterior margin with marginal series of short hairs (like those of abdomen); regions of latero-posterior angles dark brown, the color extending forward narrowly along the lateral margins. Sternal markings composed of a small median blotch on prothorax, with posterior produced point and lateral linear processes; curving intercoxal lines on mesothorax and short straight ones on metathorax, with a broad pale colored median blotch. Legs concolorous with head and thorax, with coxæ distinctly margined with blackish brown; anterior coxæ with blunt processes about as long as but narrower than the coxæ themselves.

Abdomen more golden or yellowish brown than head and thorax; very broadly elliptical; but slightly turbinated; with two or three rather short hairs in posterior

angles; a single transverse series of short hairs along posterior margin of each segment; broad, transverse bands entirely covering each segment; darker at lateral margin, especially on anterior segments; last segment flatly rounded, with fringe of short hairs.

Menopon monostæchum n. sp. (Plate lxxii, fig. 4.)

Specimens from a Silver Pheasant, *Phasianus nycthemerus*, received by the zoological department of this University from Mr. A. C. Robison of San Francisco, California.

The species is like *subæquale*, Piaget (Les Pediculines, p. 463, pl. xxxvii, fig. 5), from *Euplocamus ignitus* in shape of thorax and body, but has only single series of hairs on the abdominal segments (*subæquale* has two series on each segment); in the matter of the hairs of the body the new species is like *uniseriaticum*, Piaget (Les Pediculines, p. 464, pl. xxxviii, fig. 4) from *Phasianus prælatius*, but differs from this species in not having the posterior margin or prothorax projecting backward and angulated; in both *subæquale* and *uniseriaticum* the females are smaller than the males (according to Piaget), which unusual condition does not obtain in the new species.

Description of the male. Body, length 2.06 mm., width .9 mm.; whitish, with faint brownish tinge; with inconspicuous but distinct markings of blackish brown and chestnut; with numerous long hairs.

Head, length .41 mm., width .7 mm.; front rounded, with indication of median angulation; with about ten marginal hairs of different lengths in front of the ocular emarginations, which are shallow but distinct; palpi projecting; the projecting temporal margins with several long hairs, of which two are very long; occipital margin concave, with eight long hairs; a black ocular fleck and

brown ocular blotch; occipital margin narrowly edged with brown; mandibles and adjacent lateral regions dark chestnut brown.

Prothorax with lateral angles narrowly rounded, and with a longish spine; posterior margin curving at sides, but nearly straight on metathorax, and with a marginal series of strong, long hairs; transverse chitin bar pale to uncolored, but distinct, as also the longitudinal bar at its ends. Metathorax of about same length as prothorax, and but very little if at all wider; with five strong, short spines along each lateral margin, and a series of hairs along the straight posterior margin; lateral margins narrowly bordered with blackish brown, and linear brown blotches projecting backward from anterior angles, and tapering and fading out posteriorly. Legs pale, concolorous with body.

Abdomen elliptical, with segments projecting but little laterally; posterior angles with several hairs of different lengths, the hairs longer on posterior segments until on segments 8-9 some of them are very long; lateral bands with short processes projecting inward, one in middle of lateral margin of each segment and one along each suture; no transverse blotches, or only faint indications of brownish color; last segment broad, rounded behind, with numerous long hairs.

Female. Body, length 2.3 mm., width .9 mm.; head, length .4 mm., width .72 mm.; last segment of abdomen more flatly rounded, with a tuft of hair at each posterior angle and a fringe of hairs of equal size along the posterior margin, giving the tip of abdomen a truncate appearance.

Menopon melanorum n. sp. (Plate lxxiii, fig. 1.)

Taken on a Towhee, *Pipilo erythrophthalmus* (Lawrence, Kansas).

Description of female. Body, length 1.37 mm., width .56 mm.; pale golden brown, with black occipital margin of head, blackish brown ocular blotches and mandibles, and brown transverse abdominal blotches distinct only laterally.

Head, length .31 mm., width .47 mm., rather long in comparison with its width for *Menopon*; front rounded, with usual few short hairs in front of barely projecting palpi, and two longish ones in front of ocular emarginations; the emargination distinct, shallow, and with ocular fringe; temples broad, rounded, with a few hairs of different lengths, including at least one very long hair; occipital margin concave, straight in middle, with two longish and two short hairs; occipital margin narrowly but conspicuously bordered with black; indications of widely separated, translucent, occipital bands, convex outwardly; ocular blotches small, narrow, linear, curving, blackish in middle, paling at each end; a small black ocular fleck; a brown spot on margin outside of each mandible, and connected with mandibles by indistinct brownish bands.

Prothorax with slightly produced blunt lateral angles bearing three spines; nearly straight posterior margin with four longish hairs; the chitin bars indistinct, no blotches. Metathorax with slight lateral emargination, and indications of suture between meso- and metathorax; metathorax with a spine and very long hair in posterior angles, and eight weak hairs along the posterior margin. four on each side of the bare middle part; anterior angles of mesothorax dark brown; otherwise both segments unicolorous, concolorous with pale ground color

of body. Legs concolorous with thorax, with darker indistinct marginal and terminal margins.

Abdomen short, broad, ovate, not turbinate; a single very long hair and a spine in posterior angles of segments; broad, pale brown, transverse bands across all segments but the last, these bands, however, hardly apparent on the middle region of the body, but distinct laterally, the lines of demarcation between pale and darker parts of band rather sharply defined; last segment broad, flatly rounded, uncolored, with a fine fringe of short, uncolored hairs.

Menopon incertum n. sp. (Plate lxxiii, fig. 2.)

Specimens from an American Gold Finch, *Spinus tristis*, and from a Russet-backed Thrush, *Turdus ustulatus* (Palo Alto, California). This is one of these species which might be referred almost indifferently to *Menopon* or to *Colpocephalum*. Because Giebel has referred to a somewhat similar form, *thoracicum* (Insecta Epizoa p. 287) from *Turdus viscivorus*, to *Menopon*, I assign this species to the same genus. The new species differs from *thoracicum* in the hairs of the prothorax, in the straight, not angulated, posterior margin of the mesothorax, in lacking a complete series of hairs along the posterior margin of the metathorax, in the presence of the characteristic spines of the posterior angles of the abdominal segments, and in other particulars. The ocular emarginations of the head are distinct, "fast colpocephalisch," as Giebel says of *thoracicum*.

Description of the male. Body, length 1.16 mm., width .48 mm.; pale brown, with distinct, broad, dark brown, transverse, abdominal bands, and blackish lateral bands; head two-thirds as long as wide.

Head, length .28 mm., width .44 mm.; rather elongate for *Menopon*, with distinct ocular emarginations; rounded

in front, with a few short hairs; two longer hairs (one longer than the other) in front of emargination; ocular fringe distinct; temporal margin with four long hairs, of which two are very long, and a few shorter hairs; occipital margin concave, straight in the middle; palpi projecting slightly; occipital margin narrowly bordered with black; temples clouded; a curving, blackish brown, ocular blotch, and in front of its anterior end a small, blackish brown, submarginal blotch.

Prothorax short, broad, the lateral angle being but little produced, with two short strong spines and no hair, and the posterior angles very obtuse, hardly apparent; the posterior margins flatly convex, with six short strong hairs; segment without distinct colored blotches or border; the transverse chitin bar slender, inconspicuous. Metathorax with fine but distinct suture, separating mesothorax; just behind the suture a transverse series of a few very small spines; posterior angles of metathorax with three spines and a hair, two of the spines projecting laterally, the other spine and hair projecting posteriorly; posterior margin straight, with a marginal series of hairs: the posterior angles of the segment are obtuse and project laterally conspicuously beyond the abdomen. Legs concolorous with body, with ill-defined marginal markings.

Abdomen short, elliptical, lateral margins projecting but little; posterior angles with two short, strong, distinct spines, and usually with a long hair; a broad transverse brown band entirely across each segment, paler in middle, darker at lateral extremities so as to form broad, dark, lateral bands; the sutures broad, uncolored; last segment with uncolored posterior border, flatly convex or almost straight, with a few short hairs, and at each side a long, strong, prominent hair.

Female. Body, length 1.34 mm., width .5 mm.; head, length .31 mm., width .44 mm.; thus being little larger than the male; the posterior margin of last abdominal segment is uncolored, more convex than in the male, and bears a fringe of short, fine, transparent hairs.

Menopon longicephalum n. sp. (Plate lxxiii, fig. 4.)

One male and one female taken from a domestic Pigeon, *Columba livia* (Lawrence, Kansas). Not at all like the uncommon but long known *Menopon* of the Pigeon, *giganteum*, Denny (Anoplur. Brit., p. 225, pl. xxi, fig. 2), or *latum*, Piaget (Les Pediculines, p. 457, pl. xxxvii, fig. 1), but an elongate slender form with head nearly two thirds as long as wide, much like *brevipes*, Piaget (Supplement, 1885, p. 110, pl. xii, fig. 1), from *Crossoptilon mantschuricum*, or *triseriatum*, Piaget (Les Pediculines, p. 460, pl. xxxvii, fig. 3), from *Galus bankiva*.

Description of male. Body, length 1.5 mm., width .66 mm.; elongate, with narrow tapering head and narrow tapering posterior region of abdomen; whitish, with translucent lateral bands and with inconspicuous head markings.

Head, length .31 mm., width .47 mm.; thus being elongate and narrow for *Menopon*; front parabolic, with one short hair on each side in front of slightly projecting palpi, and one long hair and two short in front of the shallow ocular signature; emargination with ocular fringe running slightly on temporal margin; temples protruding but little laterally, and with one long hair and three short ones; occipital margin weakly concave, with a few hairs of different lengths; small, black, ocular fleck and pale, clear, brownish coloration at side of and behind mandibles.

Prothorax short, broad, with produced lateral angles with a spine in each angle, and a series of fourteen strong, sharply pointed hairs along the convex posterior margin; no blotches. Metathorax short, broad; lateral margin with two or three spines, angles with a hair and nearly straight posterior margin with a series of hairs weaker than those of the prothorax. Legs pale, concolorous with body, with short stiff hairs on femora and tibiæ.

Abdomen elliptical, narrow at both ends, with numerous strong hairs in posterior angles of segments and on lateral margins; numerous hairs on dorsal surface; whole abdomen whitish, with narrow, clear, lateral bands, with lateral processes projecting inward from anterior angles of each segment; last segment uncolored, parabolic, with four hairs on posterior margin, two near each end and none in the middle.

Female. Body, length 1.6 mm., width .69 mm.; head, length .31 mm., width .47 mm.; abdomen elongate-ovate, tapering at posterior end, the last segment uncolored, narrowly rounded behind, with a fringe of fine uncolored hairs along posterior margin.

Menopon dissimile n. sp. (Plate lxxiii, fig. 5.)

One male, one female, and one immature specimen, from the Purple Martin, *Progne subis* (Lawrence, Kansas), resembling somewhat *M. rusticum*, Giebel (Insecta Epizoa, p. 288), from *Hirundo rustica* and *H. riparia*, but more than a third larger, without the well marked antennæ and ocular bands of *rusticum*, and with spines and hairs on the prothorax, which is bare in *rusticum*. This species and *rusticum* present a *Menopon* type which in the shape and character of the head and thorax and in the sternal markings approaches *Nitzschia*.

Description of the male. Body, length 1.8 mm., width .62 mm.; pale, clear, yellowish brown, with small black ocular flecks, slightly darker thorax, indistinctly indicated lateral bands, parallel inner longitudinal bands, and numerous short, stiff, spiny hairs on dorsal surface of abdomen.

Head, length .35 mm., width .55 mm.; not so much wider than long as usual in *Menopon*; forehead or region in front of ocular emargination long; front flatly rounded, with a few short hairs and two longish ones, one longer than the other on a slight swelling in front of the ocular emargination; the ocular fringe distinct, composed of curving, stiff hairs; temples with anterior angles somewhat produced, and four long and two or three short hairs on the margin; small black ocular flecks; weakly colored, translucent, narrow, curving, ocular blotches, and a weakly colored region outside of each mandible; occipital margin medially, narrowly, weakly colored, translucent, with two short median hairs and a shorter one at each side of these two.

Prothorax hexagonal, almost as long as broad, the lateral anterior sides short, the lateral angles obtuse, but little produced, with two spines and a short, stiff hair; posterior margin slightly angulated in the middle, and with six longish hairs, the terminal one being in the posterior angles of the segment; whole segment slightly darker than the head, with short, transverse, uncolored, chitin bar. Metathorax with lateral emargination and faint sutural line between meso- and metasegments; lateral margins bare; posterior angles with two spines and the terminal one of a series of submarginal hairs which are ranged along the straight or very weakly convex posterior margin; anterior angles and lateral margin slightly darker, but otherwise the whole segment concolorous with prothorax.

Legs with weakly colored, translucent, dorsal margins on femora and tibiæ; anterior coxæ with bluntly conical processes. Sternal markings ill-defined but apparently composed of longitudinal and transversal narrow bands without median blotches.

Abdomen elongate-elliptical, slightly turbinate, with a strong hair in each posterior angle and a few short hairs along the lateral margins of the segments; dorsal surface with a regular row of short, sharp, spiny hairs on the posterior margin of each segment; on segment 1 no other dorsal hairs; on segment 2 an additional single irregular row across the segment, and on segments 3-8 two additional irregular rows; last segment without rows of short spiny hairs, rounded behind, with four long hairs in lateral groups of two each, and posterior margin with four short, fine hairs; segment 8 has two long conspicuous hairs rising one in the middle of each lateral half of the posterior margin; genitalia of the usual *Menopon* type, an unpaired, long, strong, longitudinal bar with two strong, diverging prongs at posterior angle; ventral surface of abdomen possesses, in addition to transverse rows, groups of short spiny hairs near each lateral margin; on the posterior margin of segment 2 there are a few, four to six, very strong spines in two lateral groups; color of abdomen same as that of head and legs, with narrow, translucent, lateral bands, having two short, rounded, inward-projecting processes in each segment; in addition there is a second inner, narrow, regular, lateral band parallel with the outer margin.

Female. Body, length 2.16 mm., width .81 mm.; head, length .34 mm., width .56 mm.; darker, without second inner lateral band, and with the inward-projecting process of the outer or true lateral band shorter, but the band distinctly darker colored than rest of body, although

subtranslucent; metathorax also with distinct dark subtranslucent lateral bands; dorsal surface of abdomen without short spiny hairs, and with a few longer weak hairs arranged in complete transverse rows on segments 1-3, but decreasing in number on posterior segments; last segment with posterior margin rounded about as in male, but with fringe of closely set, short, weak, finely pointed hairs; ventral surface of abdomen with the lateral groups of short spiny hairs as in male.

Menopon mesoleucum Nitzsch. (Plate lxxiii, fig. 3.)

Germar's Mag. Entomol., 1818, vol. iii, p. 300.

Ricinus cornicis De Geer, Mem. Ins., 1778, vol. vii, pl. 4, fig. 11.

Menopon mesoleucum N., Burmeister, Handb. f. Ent., 1835, vol. ii, p. 439; Giebel, Zeitschr. f. ges. Naturwiss, 1866, vol. xxvii, p. 119; ibid, Insecta Epizoa, 1874, p. 281, pl. xiv, figs. 11, 12; Piaget, Les Pediculines, 1880, p. 426, pl. xxxiv, p. 7.

A large variety of this species from the American Crow, *Corvus americanus* (specimens from Lawrence, Kansas, and Palo Alto, California). Nitzsch's type-specimens were taken from *Corvus cornix* and *C. corone*. The American specimens are uniformly larger than the type-form (length of *mesoleucum*, male 1.4 mm., female 1.8 mm.; length of var. *americanum*, male 1.7 mm., female 2.12 mm.), and vary from the descriptions of Giebel and Piaget in various particulars.

Var. *americanum* Kellogg. Males, females and young from the American Crow, *Corvus americanus* (Lawrence, Kansas, and Palo Alto, California). Male. Body, length 1.7 mm., width .7 mm.; head, length .34 mm., width .6 mm. Female. Body, length 2.12 mm., width .75 mm.; head, length .37 mm., width .69 mm.

The species may be readily recognized by the marked difference in the sexes, the female having the metathorax produced backward and angulated on the abdomen

(straight in the male), and with the transverse abdominal blotches of the first three or four segments broken in the middle and the lateral parts projecting diagonally inward and backward; in the male the blotches run evenly across the segments. I figure the male.

Nitzschia dubius n. sp. (Plate lxxiii, fig. 6.)

A few specimens from the Chimney Swift, *Chaetura pelagica* (Lawrence, Kansas). Much like *Nitzschia pulicaris*, Nitzsch, from the European Swift, *Cypselus apus*, but differs in lacking the pustulated hairs of temples and abdomen, and in the shape of the metathorax. The specimens are in poor condition and permit of only an unsatisfactory description.

Body, length 2.22 mm., width .88 mm.; elongate, with narrow neck-like prothorax; expanded posterior portion of abdomen with numerous very long hairs; head, thorax and legs pale, abdomen much darker.

Head, length .41 mm., width .72 mm.; shape of head of *pulicaris*, that is, triangular, with rounded front, a shallow concavity of the margin where the palpi project, a shallow ocular emargination, with conspicuous ocular fringe and expanded temples, the margins angulated in front and behind; the margin of forehead with six hairs on each side, the third and sixth being long; the temporal margins with four long hairs weakly pustulated, and a few very short hairs or spines; occipital margin concave, straight in middle, with four longish hairs; ground color pale tawny, with very small, black, ocular flecks, weakly colored, small, brownish, ocular blotches, strongly colored mandibles, and a weakly colored region outside of each mandible.

Prothorax subquadrangular, with shortly produced rectangular angles in lateral margins before the middle, each

angle with two spines and a hair; posterior angles rounded and the nearly straight, slightly sinuous, posterior margin with six weak hairs; a weakly indicated, uncolored, transverse, chitin bar about even with lateral angles; no distinct blotches. Meso- and metathorax fused, although the line of fusion is marked by a lateral emargination and by an indicated transverse suture; posterior angles of metathorax with two spines and a hair; the straight posterior margin with a submarginal series of short and longer hairs interrupted at the middle; on the dorsal surface of the metasegment six short spines arranged in two diagonal series of three each. Legs long, slender, concolorous with thorax, with fringes of short hairs along dorsal margins of femora and tibiæ. Sternal markings weakly indicated but of the type described as characteristic of *Nitzschia*, consisting essentially of an open quadrilateral without median blotches.

Abdomen widening posteriorly to segment 6; segment 7 a little narrower than segment 6, and segments 8 and 9 narrowing more rapidly; all segments with two to three spines in posterior angles and long hairs, increasing in length and number on posterior segments, those on segments 6-9 being especially long, numerous, and hence conspicuous; segment 9 short, flatly convex behind, with two very long hairs at each end of posterior margin and a sparse fringe of five uncolored hairs along the margin; narrow, translucent, brownish, lateral bands, and the whole abdomen dark, because crossed by broad transverse bands, almost completely covering the surface: posterior margin of each segment with a series of weak hairs.

DISTRIBUTION.

Concerning the distribution of the Mallophaga, I have little to add to the remarks made in my previous paper. Among the land birds of America there are very few which are identical with the Old World species. On those are found parasites identical, or nearly so, with the Old World Mallophaga of the same hosts. On the domestic pigeon, *Columba livia*, I find *Lipeurus baculus* and *Goniocotes compar*, both common on the European individuals of the same host species. In addition, I find a *Menopon* on the pigeon not met with by the European authors. On the Snow Owl, *Nyctea nyctea*, I find *Docophoros ceblebrachys*, described by Nitzsch from the same host. And there are a few other similar examples.

As among the water birds, where I have found previously described Mallophaga on American birds not identical with Old World species, these parasites have been found, almost always, on American birds very closely related to the European hosts. For example, the characteristic *Docophorus rostratus* Nitzsch, of the European Barn Owl, *Strix flammea*, I have found on the American Barn Owl, *Strix pratincola*. It is of interest to note that the American owl has been until recently ranked as a variety simply of the European species. The striking *Menopon mcsoleucum* of the various Old World crows (*Corvus corone*, *frugilegus*, et al.), is found on the American Crow, *Corvus americanus*, though showing such constant differences as to compel me to give it a varietal name. There are several other examples of this condition presented in this paper.

Apparent exceptions to the general statement that American Mallophaga identical with Old World species are found on American hosts identical with or very nearly

related to Old World hosts, are presented by *Docophorus communis* and *Nirmus fuscus*. These two parasite species are found, common, in one case, to many passerine birds, and in the other, to several raptorial birds, which differ generically from the Old World hosts. It will be noted, however, that both of these species have a wide range of hosts in both Europe and America. The fact is that we have to do here, in each case, with a group of closely allied, insensibly gradating forms, rather than with a single well marked Mallophagous species. That this condition has been recognized by the European authors is shown in the cases of both *Docophorus communis* and *Nirmus fuscus*, by the attempts which have been made by Giebel and Piaget to break up these species into several distinct species (Giebel), or into subspecies (Piaget).

Finally with regard to the constant or occasional appearance of the parasites on the hosts, I can add also but little. In the preparation of this paper I have had no such long series of specimens of one bird species as it was my privilege to have of certain species of maritime birds. As an illustration of the varying degrees of prevalence of different parasite species infesting a single bird species, the parasites of *Carpodacus mexicanus frontalis*, the House Finch, may be referred to. Of nine specimens of this bird species examined, six were infested by *Docophorus communis*, four by *Nirmus vulgatus*, and one by *Physostomum microcephalum*. Of three specimens examined of the closely related *Carpodacus purpureus californicus*, the California Purple Finch, *Docophorus communis* was found on each, but no *Nirmus* nor *Physostomum* on any. *Physostomum* as a parasite, however, is not always uncommon on its host, as the case of *Physostomum diffusum*, found on five out of seven specimens of *Melospiza fasciata samuelis*, attests.

Comparing the land birds with the water birds as hosts for Mallophaga, I find that many more individuals among land birds than among water birds are free from parasites, and that among the infested birds the number of individuals of Mallophaga on a single bird individual is much greater among the water bird species than among the land bird species. It is noticeable that the larger land birds such as hawks and grouse show many more parasites than the smaller birds; and to some extent the greater abundance of parasites on water birds may be due to their distinctly larger average size as compared with land birds.

LIST OF HOSTS AND PARASITES.

<i>Colinus virginianus</i> .	<i>Haliaeetus leucocephalus</i> .
<i>Lipeurus dissimilis</i> .	<i>Nirmus discocephalus</i> var. <i>amblys</i> .
<i>Callipepla californica</i> .	<i>Colpocephalum flavescens</i> .
<i>Lipeurus docophoroides</i> .	<i>Bubo virginianus</i> .
<i>Goniodes mammillatus</i> .	<i>Docophorus cursor</i> .
<i>Phasianus nythemerus</i> .	<i>Nyctea nyctea</i> .
<i>Lipeurus introductus</i> .	<i>Docophorus ceblebrachys</i> .
<i>Goniodes cervinicornis</i> .	<i>Strix pratincola</i> .
<i>Goniocotes creber</i> .	<i>Docophorus rostratus</i> .
<i>Meuopon monostœchum</i> .	<i>Dryobates pubescens</i> .
<i>Columba livia</i> .	<i>Docophorus evagans</i> .
<i>Lipeurus baculus</i> .	<i>Melanerpes formicivorus bairdi</i> .
<i>Goniocotes compar</i> .	<i>Docophorus californiensis</i> .
<i>Menopon longicephalum</i> .	<i>Colaptes auratus</i> .
<i>Elanus leucurus</i> .	<i>Docophorus alienus</i> .
<i>Colpocephalum osborni</i> .	<i>juugens</i> .
<i>Meuopon decoratum</i> .	<i>Chordeiles virginianus heuryi</i> .
<i>Circus hudsonius</i> .	<i>Lipeurus macrocephalus</i> .
<i>Nirmus fuscus</i> .	<i>Chaetura pelagica</i> .
<i>Buteo swainsoni</i> .	<i>Nitzschia dubius</i> .
<i>Nirmus fuscus</i> .	<i>Trochilus anna</i> .
<i>Archibuteo lagopus sancti-johannis</i> .	<i>Nirmus eustigmus</i> .
<i>Docophorus taurocephalus</i> .	<i>Trochilus rufus</i> .
<i>Nirmus fuscus</i> .	<i>Nirmus suodgrassi</i> .
<i>Colpocephalum flavescens</i> .	

- Tyrannus tyrannus.*
Physostomum angulatum.
Empidonax difficilis.
Physostomum sucinaceum.
Otocoris alpestris.
Docophorus communis.
Corvus corax sinuatus.
Docophorus distinctus.
Corvus americanus.
Docophorus atratus.
Menopon mesoleucum var. *americanum.*
Colpocephalum subæquale.
Molothrus ater.
Docophorus transpositus.
Agelaius phœniceus.
Docophorus communis.
Nirmus illustris.
Sturnella magna neglecta.
Docophorus communis.
Icterus bullocki.
Docophorus communis.
Carpodacus purpureus californicus.
Docophorus communis.
Nirmus vulgaris.
Carpodacus mexicanus frontalis.
Docophorus communis.
Nirmus vulgaris.
Physostomum microcephalum.
Spinus tristis.
Menopon incertum.
Spinus psaltria.
Docophorus communis.
Spinus pinus.
Docophorus communis.
Calcarius lapponicus.
Docophorus communis.
Ammodramus sandwichensis.
Docophorus communis.
Physostomum diffusum.
Zonotrichia coronata.
Nirmus vulgaris.
Physostomum diffusum.
- Zonotrichia gambeli.*
Nirmus vulgaris.
Junco hyemalis.
Docophorus communis.
Nirmus vulgaris.
Physostomum diffusum var. *pallidum.*
Melospiza fasciata samuelis.
Physostomum diffusum.
Colpocephalum chrysophæum.
Passerella iliaca.
Physostomum angulatum.
Pipilo erythrophthalmus.
Menopon melanorum.
Pipilo fuscus crissalis.
Nirmus vulgaris.
Pipilo maculatus megalonyx.
Nirmus vulgaris.
Cardinalis cardinalis.
Docophorus communis.
Passerina versicolor.
Physostomum australe.
Progne subis.
Docophorus domesticus.
Menopon dissimile.
Petrochelidon lunifrons.
Docophorus excisus var. *major.*
Nirmus longus.
Tachycineta bicolor.
Docophorus excisus var. *major.*
Nirmus longus.
Ampelis garrulus.
Docophorus communis.
Ampelis cedrorum.
Docophorus incisus.
Lanius ludovicianus excubitorides.
Docophorus communis.
Harporhynchus rufus.
Docophorus communis.
Psaltiriparus minimus.
Colpocephalum fumidum.
Menopon robustum.

Turdus ustulatus.

Sialia sialis.

Menopon incertum.

Docophorus incisus.

Merula migratoria.

Docophorus communis.

Nirmus vulgatus.

simplex.

EXPLANATION OF PLATES.

PLATE LX.—Fig. 1, Head of *Colpocephalum flavescens*, under side; *a* labrum, *b* labial palpi, *c* maxillary palpi, *d* antennæ (after Nitzsch). Fig. 2, Maxilla of *Trinotum conspurcatum* (after Nitzsch). Fig. 3, Labium of *Trinotum conspurcatum* (after Nitzsch). Fig. 4, Labium of *Tetrothalamus chilensis* [*Menopon titan*]; *m* mentum, *pl* labial palpus, *g* glossa, *pg* paraglossa, *hy* hypopharynx (after Grosse). Fig. 5, Labium of a *Nirmus*; *g* glossa, *pg* paraglossa (after Grosse). Fig. 6, Head, ventral aspect, with median part of labium cut away, of *Ancistrona gigas*; *lb* labrum, *md* mandible, *lp* labial palpus, *hy* hypopharynx, *fk* labial fork, *af* antennary fossa. Fig. 7, Labium, ventral aspect, of *Ancistrona gigas*; *sm* submentum, *m* mentum, *pr* labial prong, *p* palpifer, *lp* labial palpus, *lig* ligula, *g* glossa, *pg* paraglossa. Fig. 8, Maxilla of *Ancistrona gigas*. Fig. 9, Right mandible, ventral aspect, of *Ancistrona gigas*; *ten* tendon, *mus* muscle, *vchr* ventral chitinous rod, *dchr* dorsal chitinous rod. Fig. 10, Mandibles, ventral aspect, of *Ancistrona gigas*; *c* condyles, *r* right mandible, *l* left mandible. Fig. 11, Hypopharynx of *Ancistrona gigas*. Fig. 12, Left labial fork, ventral aspect, of *Ancistrona gigas*; *mus* muscle.

PLATE LXI.—Fig. 1, Head, ventral aspect, of *Lamobothrium* sp.; *sm* submentum, *m* mentum, *ant* antenna, *clyp* clypeus, *lb* labrum, *md* mandible, *mx* maxilla, *g* glossa, *pg* paraglossa, *lp* labial palpus. Fig. 2, Mandibles, ventral aspect, of *Lamobothrium* sp.; *c* condyles, *r* right mandible, *l* left mandible. Fig. 3, Right maxilla, ventral aspect, of *Lamobothrium* sp. Fig. 4, Labium, ventral aspect, of *Lamobothrium* sp.; *sm* submentum, *m* mentum, *g* glossa, *pg* paraglossa, *pf* palpifer, *lp* labial palpus. Fig. 5, Labial glands of *Lamobothrium* sp. Fig. 6, Left maxilla, ventral aspect, of *Goniodes cervinicornis*. Fig. 7, Labium, ventral aspect, of *Goniodes cervinicornis*; *g* glossa, *pg* paraglossa. Fig. 8, Mandibles, posterior aspect, of *Goniodes cervinicornis*. Fig. 9, Right mandible, posterior aspect, of *Goniodes cervinicornis*; *c* condyle, *ch pls* chitinous plates.

PLATE LXII.—Fig. 1, Head, ventral aspect, with labium represented as transparent, of *Eurymetopus taurus*; *ant* antenna, *tr* trabecula, *md* mandible, *clyp* clypeus, *g* glossa, *pg* paraglossa, *æs* œsophageal sclerite, *lg* "lingual gland." Fig. 2, Œsophageal sclerite, dorsal aspect, of *Eurymetopus taurus*; *d* duct, *do* opening of duct, *mg* middle groove, *ant h* anterior horn, *bs* "bonnet string." Fig. 3, Œsophageal sclerite, lateral

aspect, of *Eurymetopus taurus*; *ant h* anterior horn, *bs* "bouquet string." Fig. 4, Right maxilla, ventral aspect, of *Eurymetopus taurus*. Fig. 5, Mandibles, ventral aspect of *Eurymetopus taurus*; *c* condyles, *r* right mandible, *l* left mandible. Fig. 6, Labium, ventral aspect, of *Eurymetopus taurus*; *sm* submentum, *m* mentum, *g* glossa, *pg* paraglossa. Fig. 7, "Lingual gland," ventral aspect, of *Eurymetopus taurus*; *d* duct, *æs* œsophageal sclerite, *ch ped* chitinous pedicle. Fig. 8, Left "lingual gland," ventral aspect, of *Eurymetopus taurus*; *d* duct, *ch ped* chitinous pedicle, *mus* muscle, *lg* the gland.

PLATE LXIII.—Fig. 1, Labium of *Colpocephalum* sp.; *sm* submentum, *m* mentum, *pf* palpifer, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 2, Labium of *Trinoton luridum*; *sm* submentum, *m* mentum, *pf* palpifer, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 3, Labium of *Nirmus* sp.; *sm* submentum, *m* mentum, *g* glossa, *pg* paraglossa. Fig. 4, Mandibles, ventral aspect, of *Menopon titan*; *c* condyles, *r* right mandible, *l* left mandible. Fig. 5, Labium of *Physostomum angulatum*; *sm* submentum, *m* mentum, *pf* palpifer, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 6, Labium of *Nitzschia dubius*; *sm* submentum, *m* mentum, *pf* palpifer, *lp* labial palpus, *g* glossa, *pg* paraglossa.

PLATE LXIV.—Fig. 1, Labium of *Termopsis angusticollis*; *sm* submentum, *m* mentum, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 2, Maxilla of *Termopsis angusticollis*; *cd* cardo, *st* stipes, *pf* palpifer, *lac* lacinia, *gal* galea, *mx p* maxillary palpus. Fig. 3, Labium of nymph of *Perla*; *sm* submentum, *m* mentum, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 4, Maxilla of nymph of *Perla*; *cd* cardo, *st* stipes, *lac* lacinia, *gal* galea, *mx p* maxillary palpus. Fig. 5, Head, ventral aspect, of *Atropos* sp.; *sm* submentum, *m* mentum, *mx* maxilla, *mx p* maxillary palpus, *md* mandible, *clyp* clypeus, *lb* labrum, *g* glossa, *pg* paraglossa, *fk* fork. Fig. 6, Mandibles of *Atropos* sp.; *c* condyles, *r* right mandible, *l* left mandible. Fig. 7, Head, dorsal aspect, of *Atropos* sp.; *clyp* clypeus, *ant* antenna, *æs* œsophageal sclerite. Fig. 8, Mandible and mandibular muscles of *Psocus* sp.; *fm* flexor muscle, *em* extensor muscle, *m* molar face of mandible (after Burgess). Fig. 9, Longitudinal section through middle of head of *Psocus* sp.; "*cl* clypeus, *l* labrum, *mand* mandible, the dotted line ending on the ribbed molar surface which tapers beneath into the sharp cutting edge; *mx* maxilla, *t* tongue, *f* fork, *lb* labium and *lp* its palpus, *m* mentum, *lg* lingual gland and *gm* its suspensory muscle, *æ* œsophagus opening below into the oral cavity at the base of which is the œsophageal bone, *æb*; *fm* flexor muscle of the mandible and *lm* the muscle of the labrum, *em* muscles of the clypeus, *gl* supra-œsophageal ganglion" (after Burgess). Fig. 10, Labium, posterior aspect, of *Psocus* sp.; "*m* mentum, *lb* labium, *lp* one-jointed labial palpus, behind which one sees the tip of the fork, *f*; *c* cardo, *p* stipes having the four-jointed-

maxillary palpus, *mx* lobe; through the mentum can be seen the lingual glands, *lg*, with their duct, *ld*" (after Burgess). Fig. 11, Oesophageal sclerite ("suboesophageal bone"), frontal aspect, of *Psocus* sp.; *ld* duct of the lingual gland (after Burgess).

PLATE LXV.—Fig. 1, *Docophorus taurocephalus* Kellogg, ♂. Fig. 2, *D. alienus* Kellogg, ♂. Fig. 3, *D. incisus* Kellogg, ♂. Fig. 4, *D. domesticus* Kellogg, ♂. Fig. 5, *D. distinctus* Kellogg, ♂. Fig. 6, *D. transpositus* Kellogg, ♀.

PLATE LXVI.—Fig. 1, *Docophorus cursor* N., ♀. Fig. 2, *D. evagans* Kellogg, ♀. Fig. 3, *D. ceclebrachys* N., ♂. Fig. 4, *D. jungens* Kellogg, ♀. Fig. 5, *D. rostratus* N., ♀. Fig. 6, *D. californiensis* Kellogg, ♂. Fig. 7, *D. communis* N., ♀.

PLATE LXVII.—Fig. 1, *Nirmus longus* Kellogg, ♀. Fig. 2, *N. simplex* Kellogg, ♀. Fig. 3, *N. eustigmus* Kellogg, ♀. Fig. 4, *N. illustris* Kellogg, ♂. Fig. 5, *N. vulgatus* Kellogg, ♀. Fig. 6, *N. discocephalus* var. *amblys* Kellogg, ♀. Fig. 7, *N. fuscus* N., ♀.

PLATE LXVIII.—Fig. 1, *Lipcurus introductus* Kellogg, ♀. Fig. 2, *L. snodgrassi* Kellogg, ♀. Fig. 3, *L. macrocephalus* Kellogg, ♀. Fig. 4, *L. baculus* N., head of ♂. Fig. 5, *L. introductus* Kellogg, head of ♂. Fig. 6, *L. baculus* N., ♀. Fig. 7, *L. dissimilis* P., head of ♀. Fig. 8, *L. docophoroides* P., ♀.

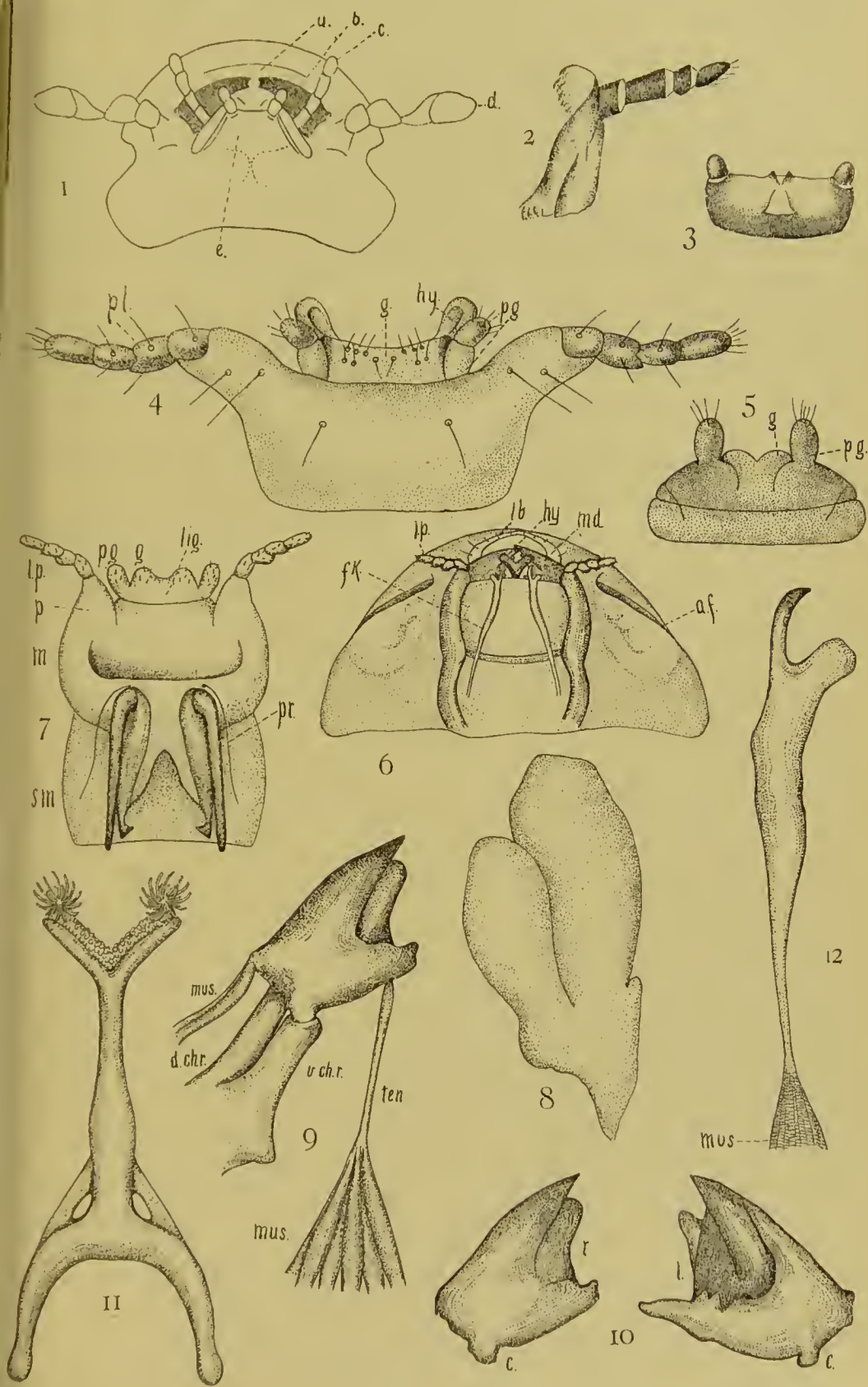
PLATE LXIX.—Fig. 1, *Goniodes cervinicornis* G., ♀. Fig. 2, *Goniodes mammillatus* Rudow, ♀. Fig. 3, *Goniocotes creber* Kellogg, ♀. Fig. 4, *Goniocotes compar* N., ♂.

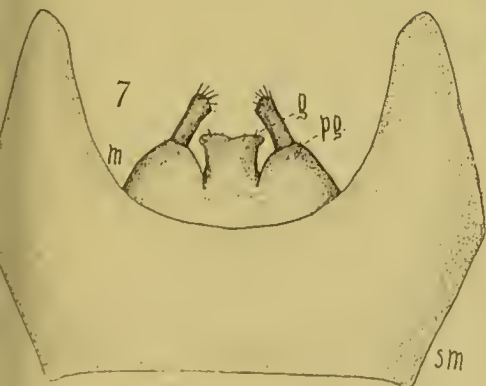
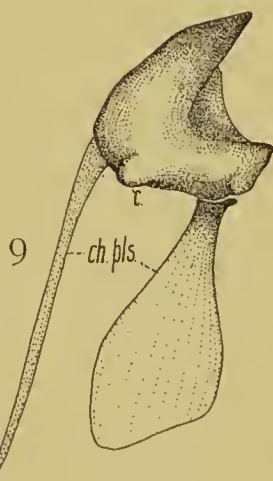
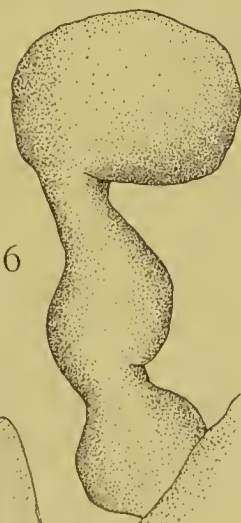
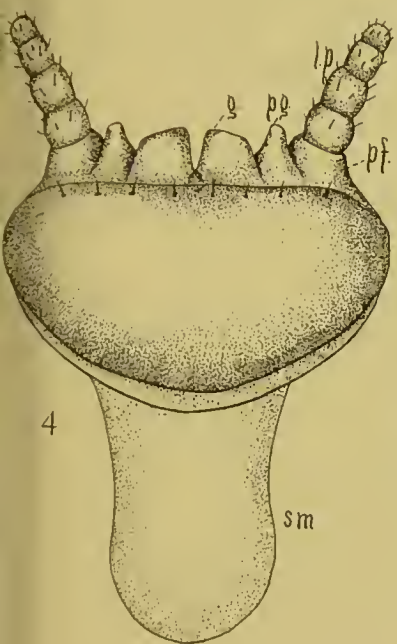
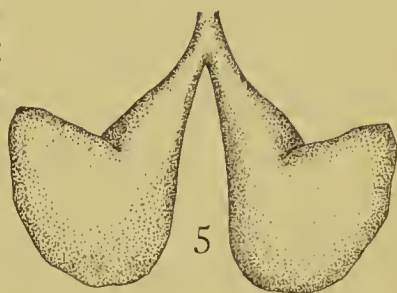
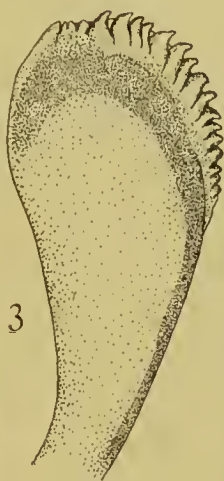
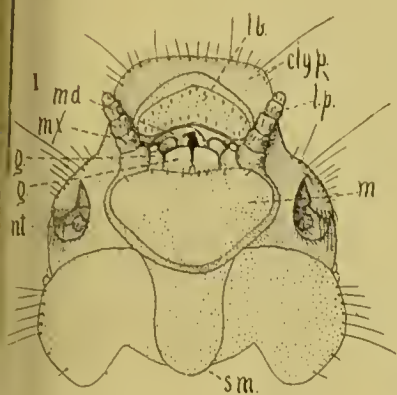
PLATE LXX.—Fig. 1, *Physostomum microcephalum* Kellogg, ♀. Fig. 2, *P. sucinaceum* Kellogg, ♀. Fig. 3, *P. diffusum* Kellogg, ♀. Fig. 4, *P. australe* Kellogg, ♀. Fig. 5, *P. angulatum* Kellogg, ♀.

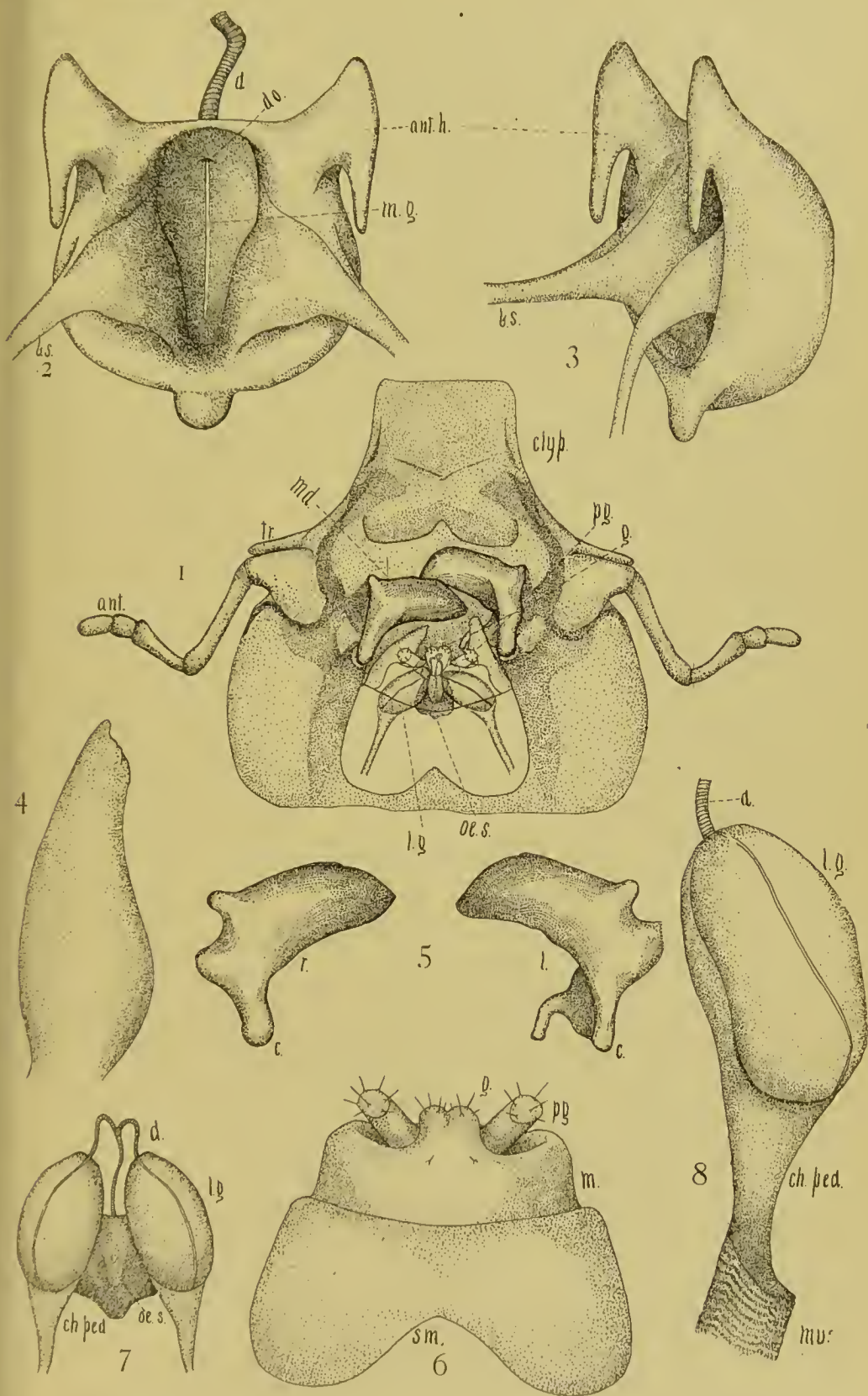
PLATE LXXI.—Fig. 1, *Colpocephalum chrysophæum* Kellogg, ♀. Fig. 2, *C. osborni* Kellogg, ♂. Fig. 3, *C. osborni* Kellogg, abdomen of ♀. Fig. 4, *C. flavescens* N., ♂. Fig. 5, *C. fumidum* Kellogg, ♀.

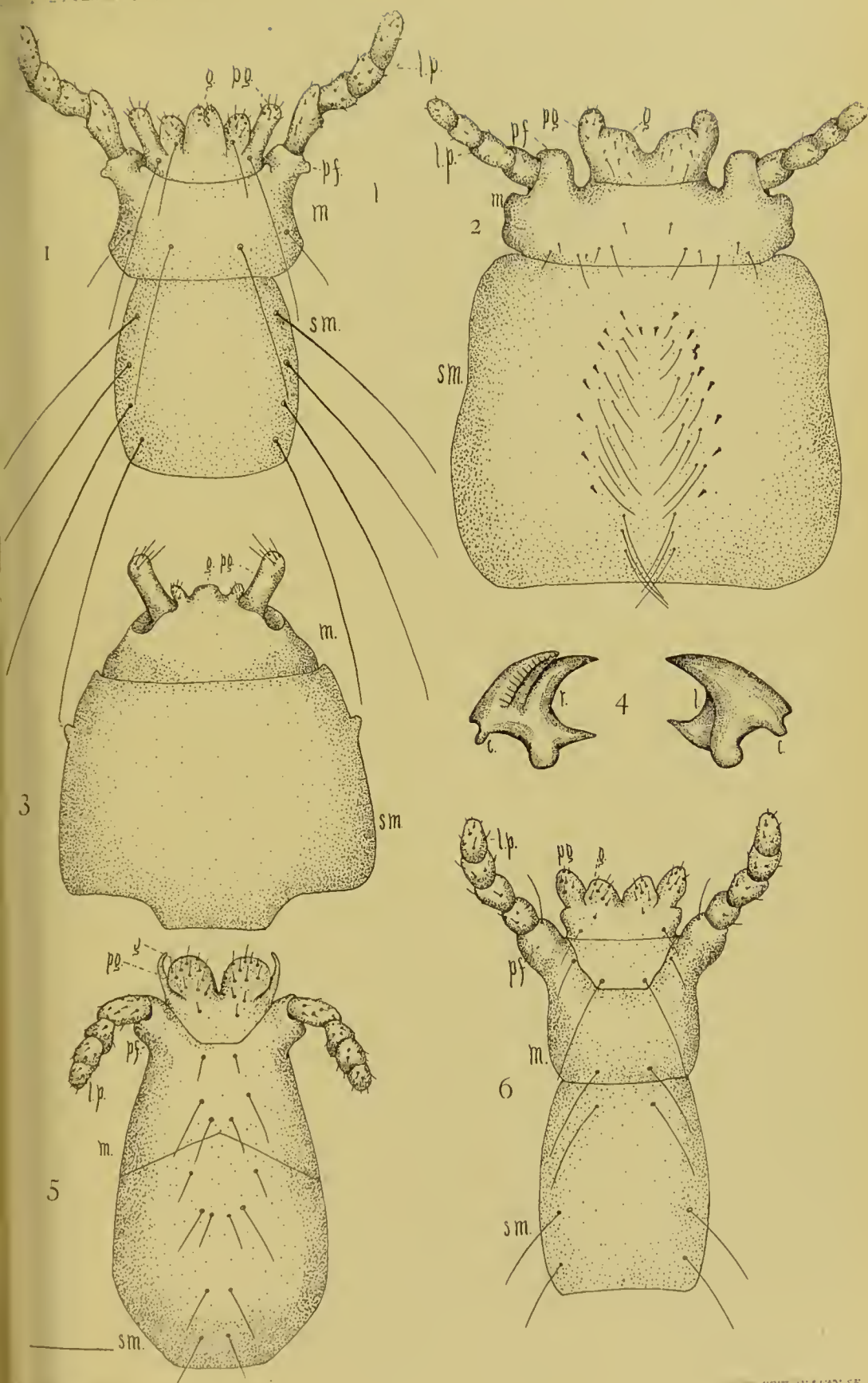
PLATE LXXII.—Fig. 1, *Colpocephalum subæquale* N., ♀. Fig. 2, *Menopon decoratum* Kellogg, ♂. Fig. 3, *M. robustum* Kellogg, ♀. Fig. 4, *M. monostachum* Kellogg, ♂.

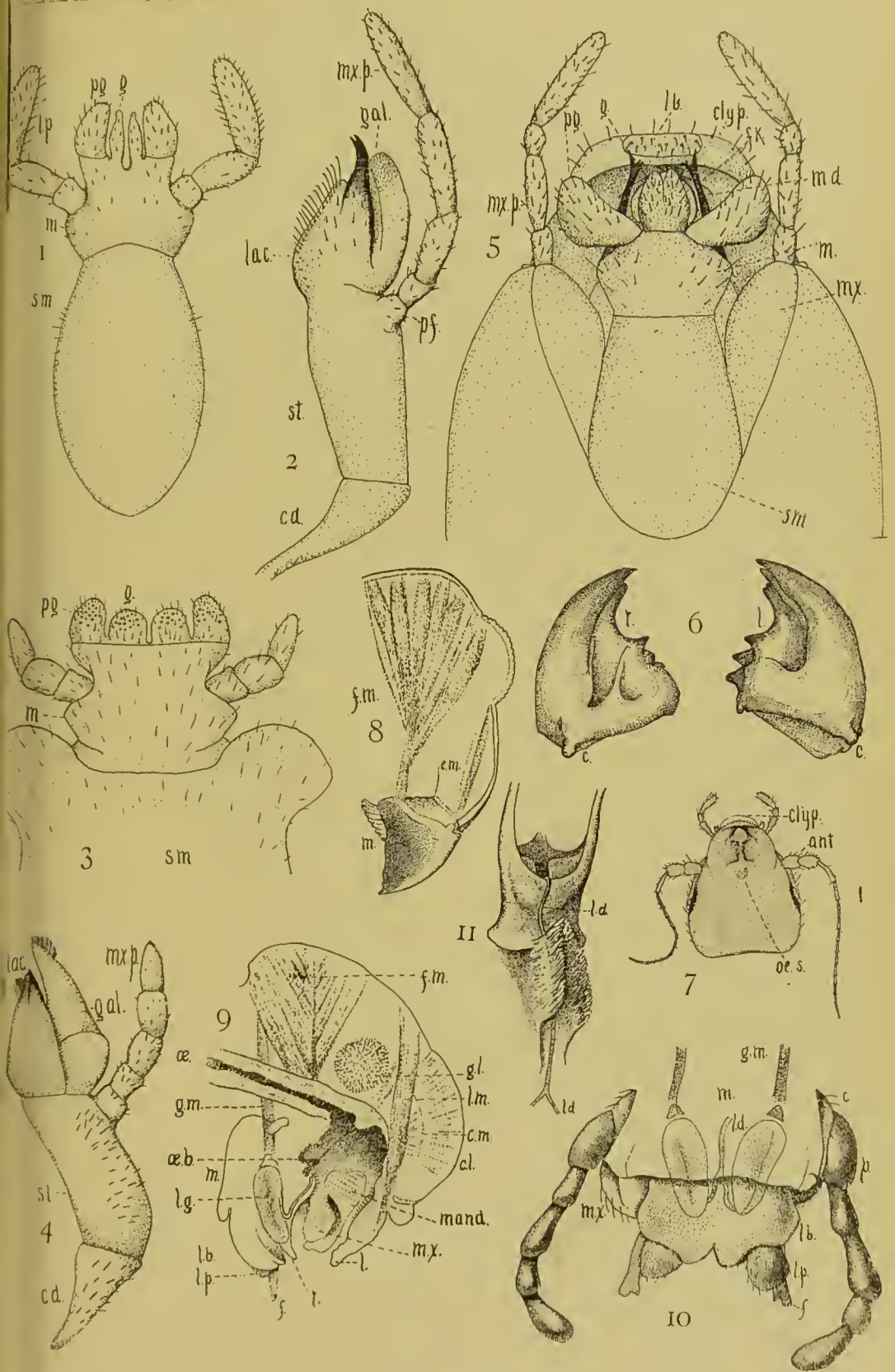
PLATE LXXIII.—Fig. 1, *Menopon melanorum* Kellogg, ♀. Fig. 2, *M. incertum* Kellogg, ♀. Fig. 3, *M. mesoleucum* N., ♂. Fig. 4, *M. longicephalum* Kellogg, ♀. Fig. 5, *M. dissimile* Kellogg, ♀. Fig. 6, *Nitzschia dubius* Kellogg, ♂ or ♀?

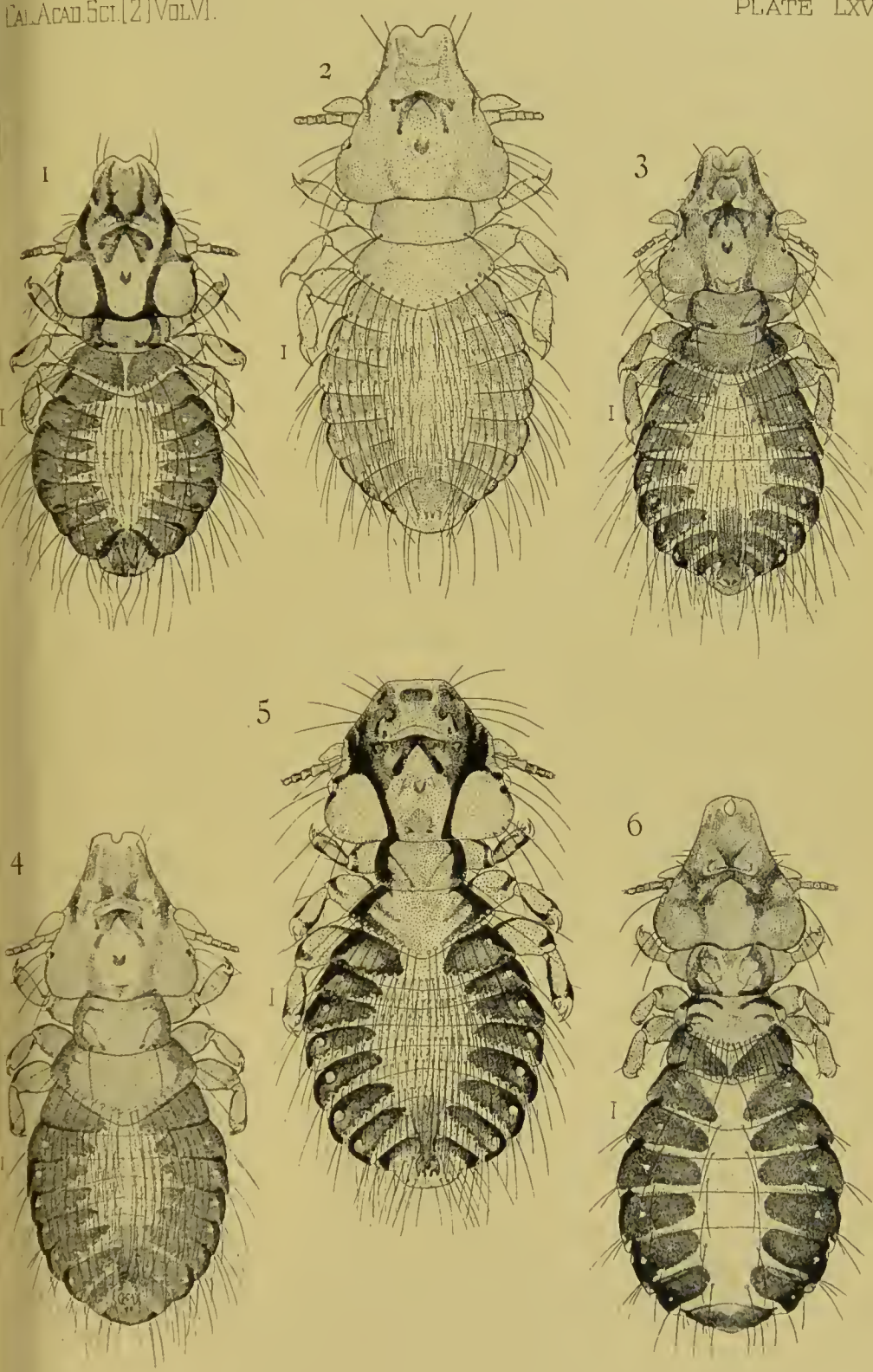


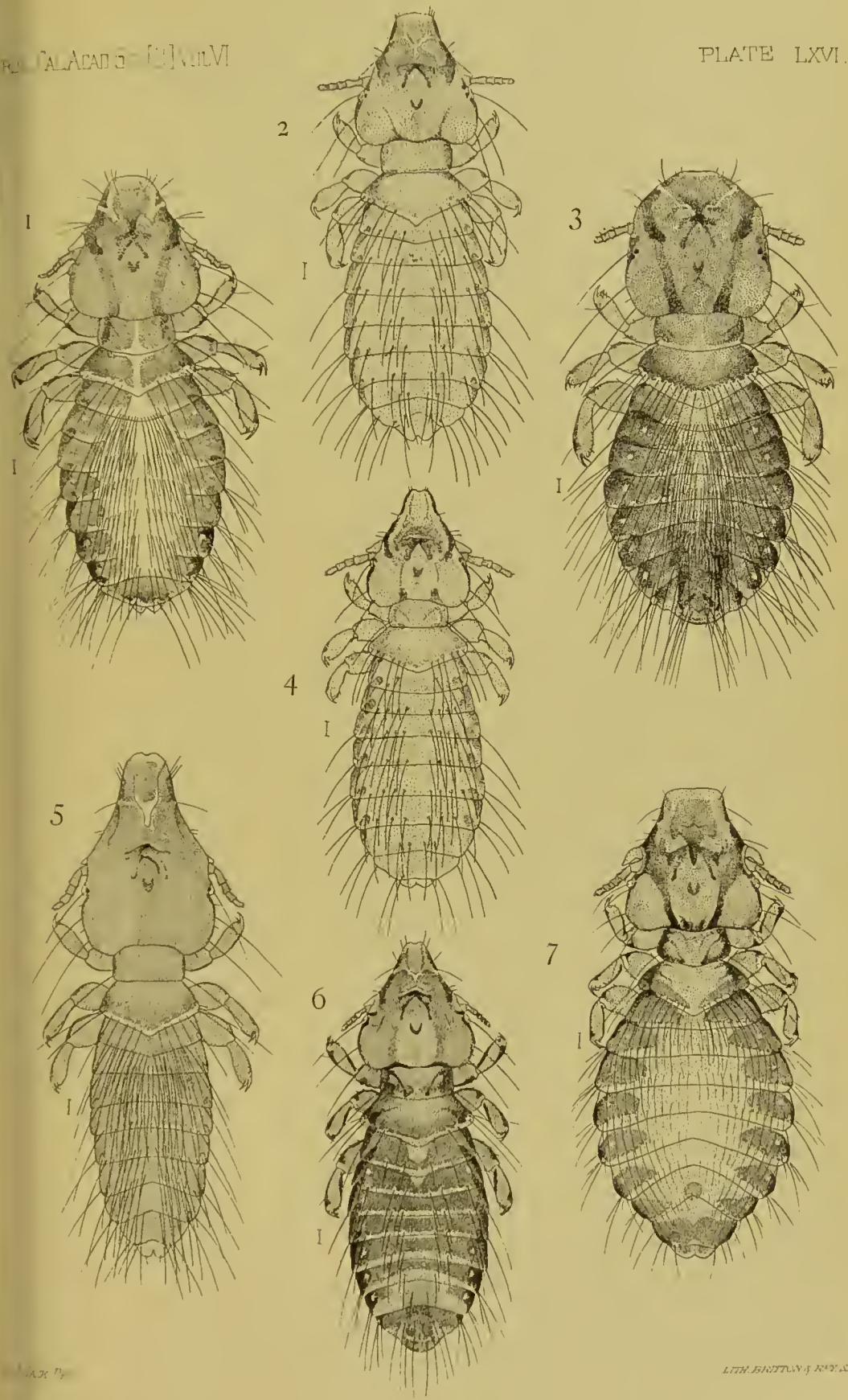


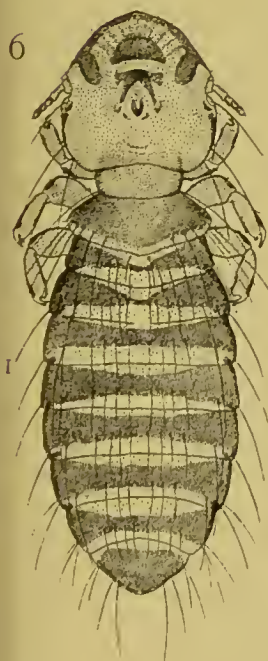
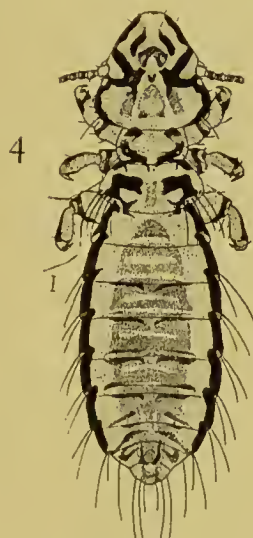
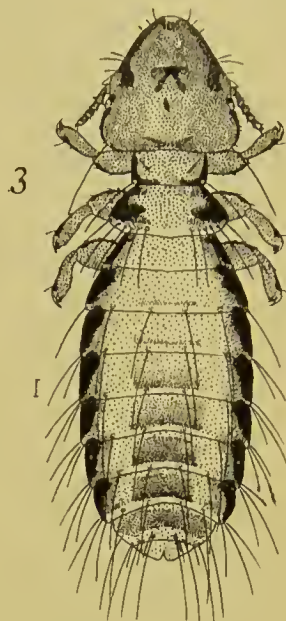
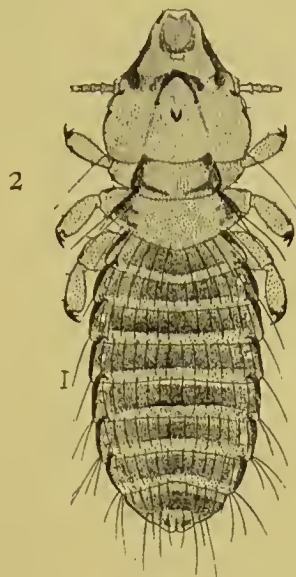
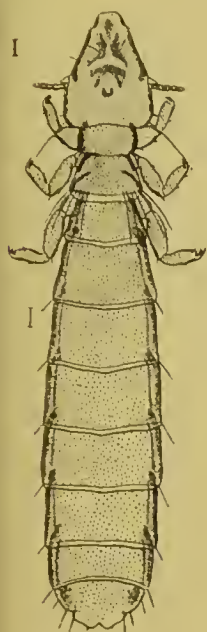


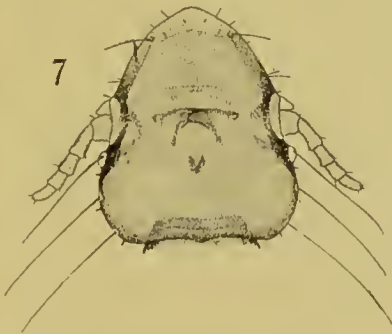
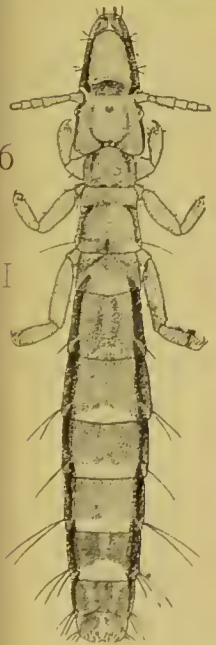
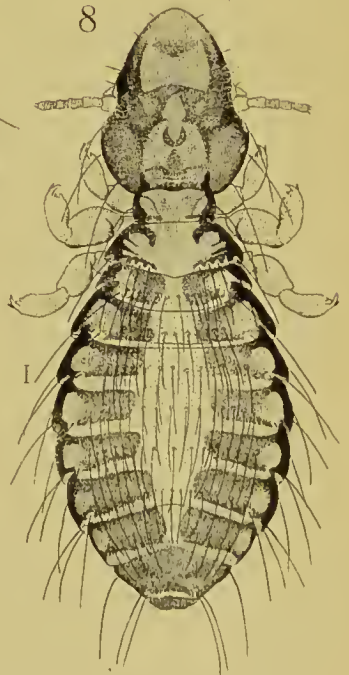
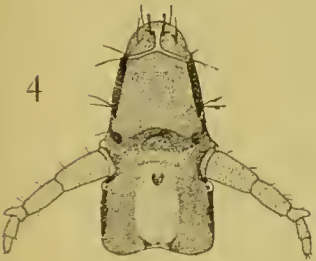
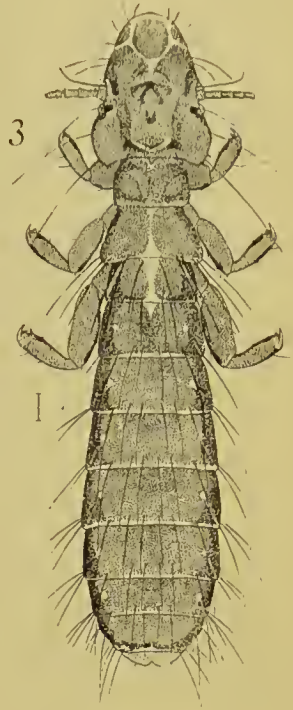
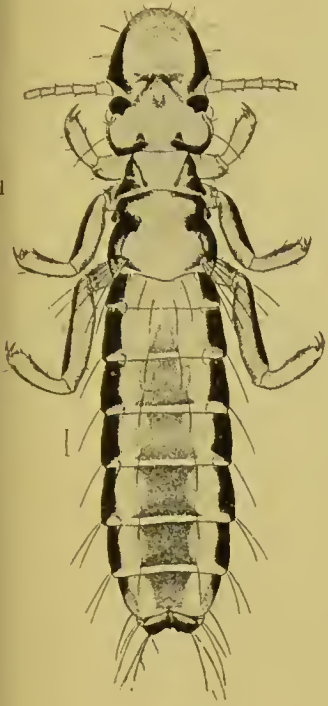


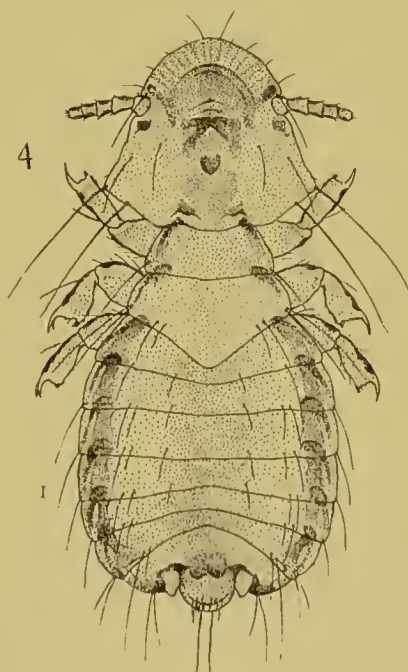
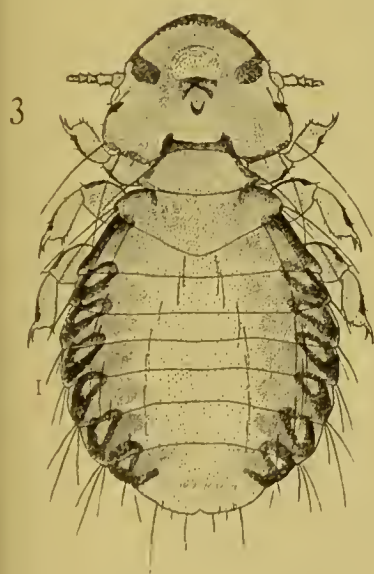
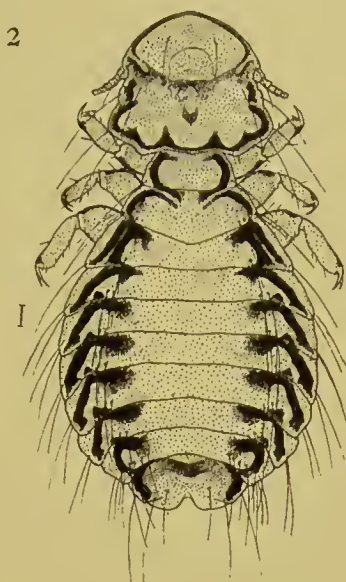
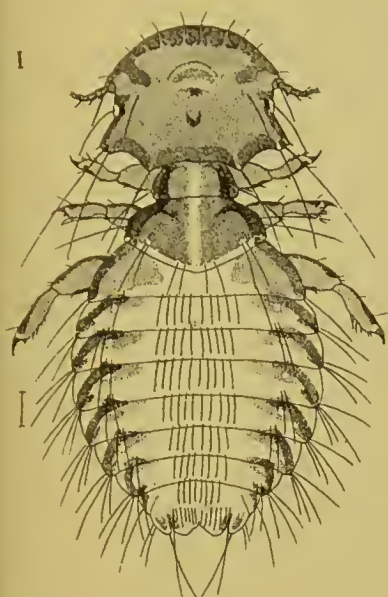


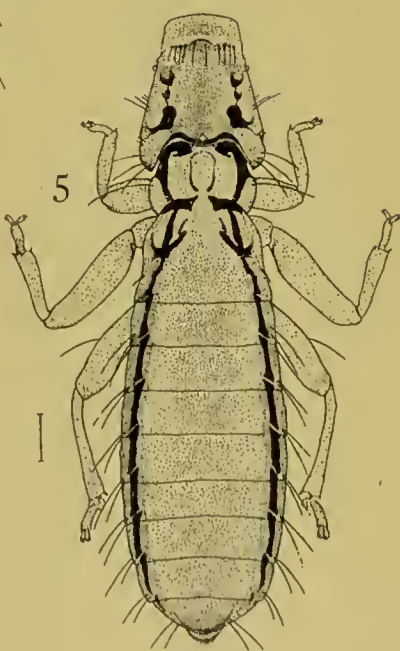
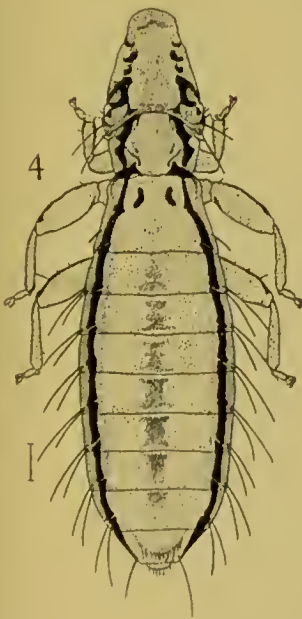
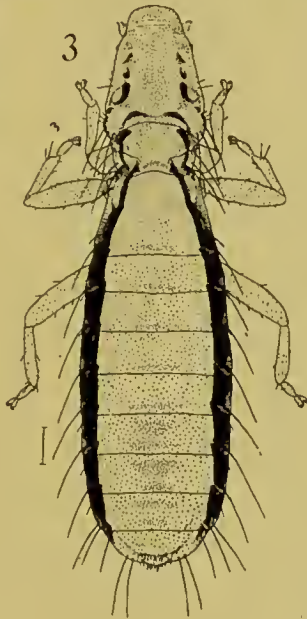
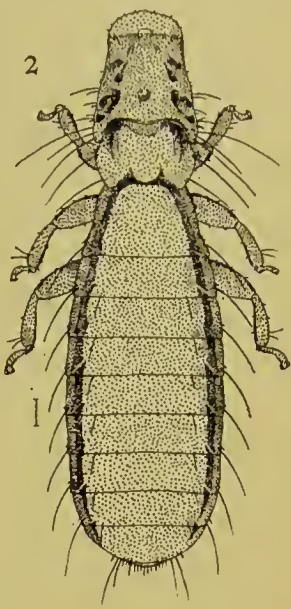
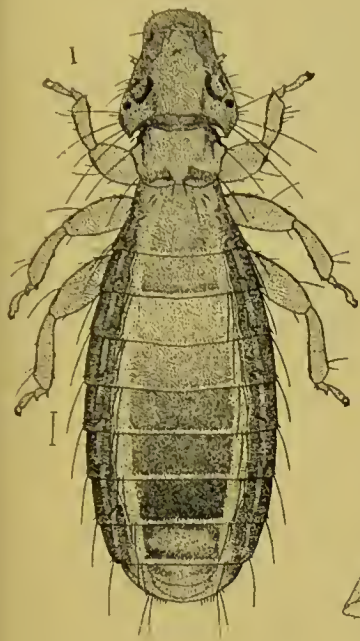


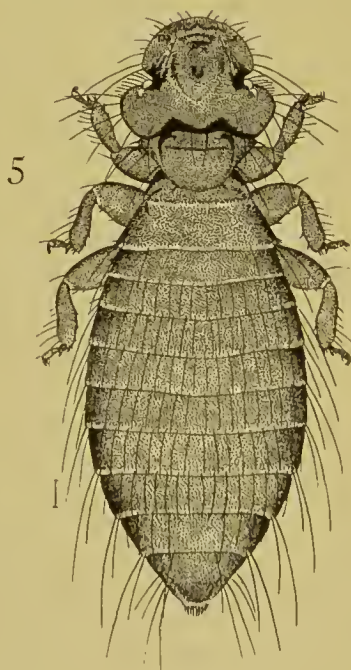
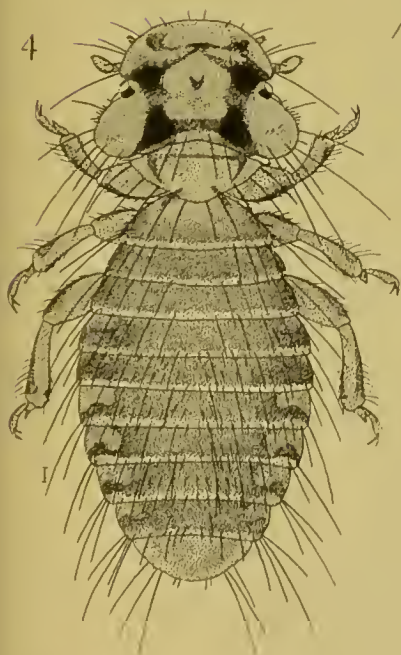
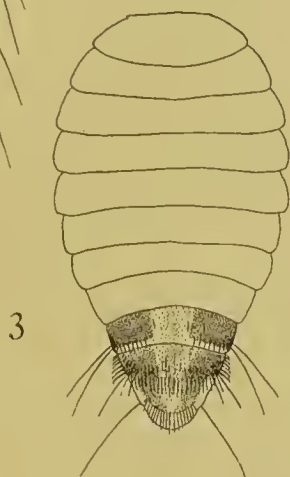
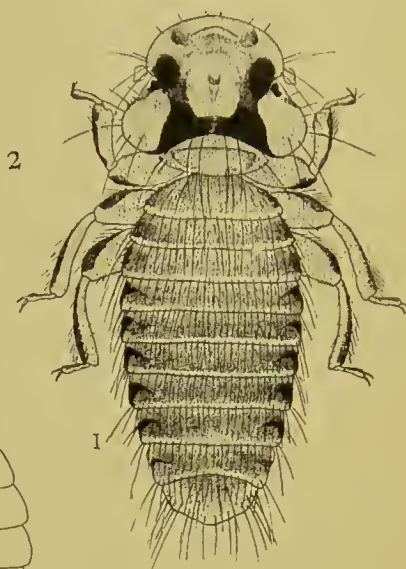
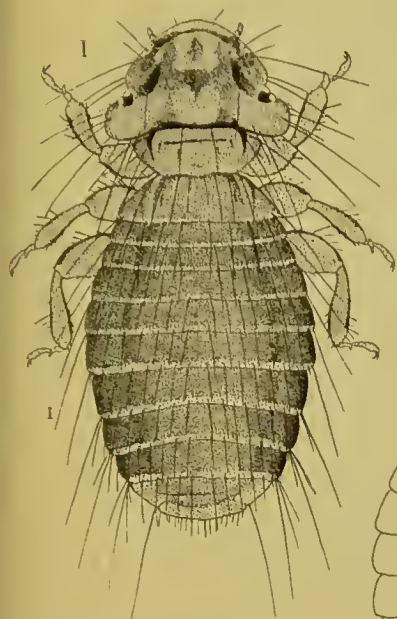


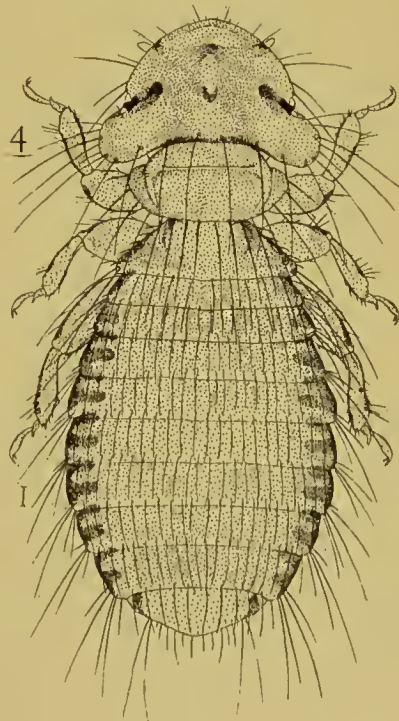
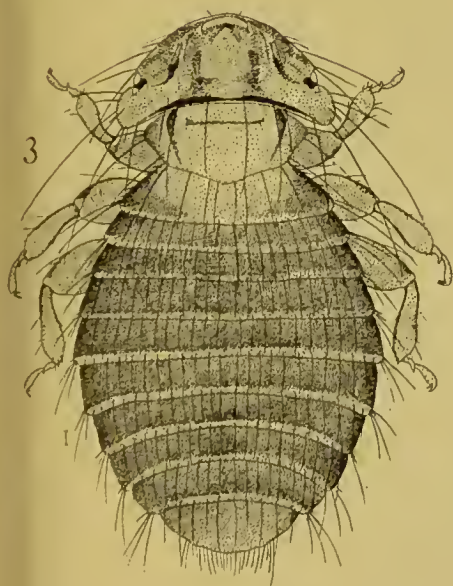
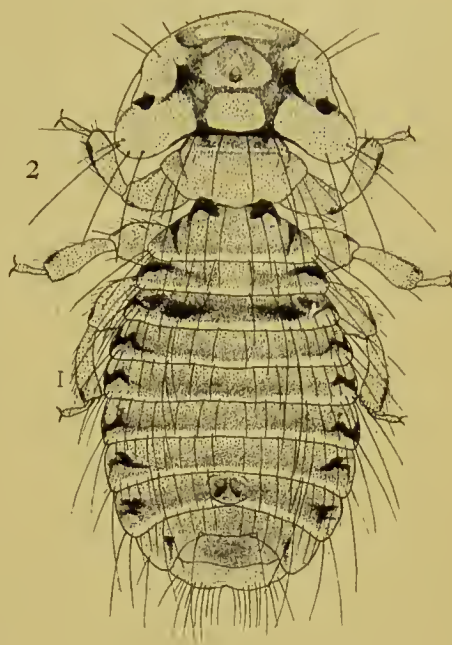
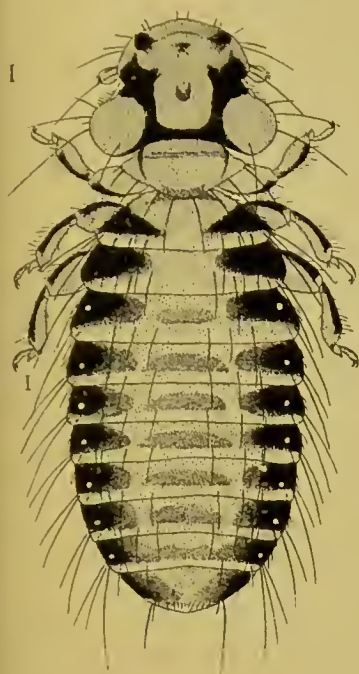


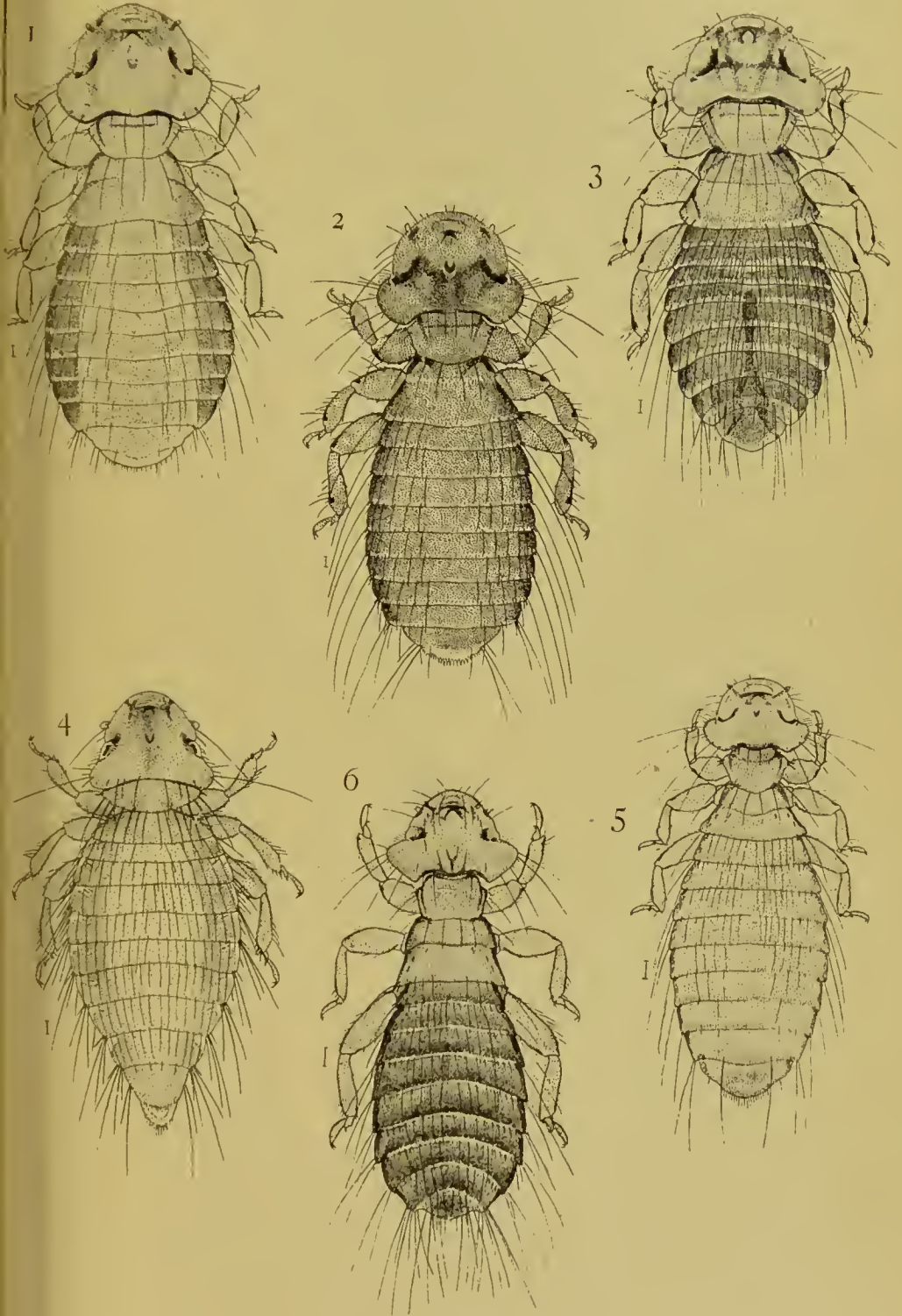












CONTRIBUTIONS TO BIOLOGY
FROM
THE HOPKINS SEASIDE LABORATORY
OF THE
LELAND STANFORD JR. UNIVERSITY

XIX

NEW MALLOPHAGA, III.

Comprising

MALLOPHAGA FROM BIRDS OF PANAMA, BAJA CALIFORNIA
AND ALASKA,

BY

VERNON L. KELLOGG,

Professor of Entomology, Leland Stanford Junior University.

MALLOPHAGA FROM BIRDS OF CALIFORNIA,

BY

VERNON L. KELLOGG AND BERTHA L. CHAPMAN.

THE ANATOMY OF THE MALLOPHAGA,

BY

ROBERT E. SNODGRASS,

Assistant in Entomology, Leland Stanford Junior University.

Reprinted from the
Occasional Papers of the California Academy of Sciences.—Vol. VI.

PALO ALTO, CALIFORNIA,

1899

PREFATORY NOTE.

This memoir is the nineteenth of a series designed to illustrate investigations and explorations connected with the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University. These investigations have been carried on by means of the assistance given by Timothy Hopkins, Esq., of Menlo Park, California. This memoir appears in the publications of the California Academy of Sciences, the present edition being a reprint.

OLIVER P. JENKINS,

CHARLES H. GILBERT,

Directors Hopkins Laboratory.

Date of publication, February 28, 1899.

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AUTHOR'S PREFACE.

The papers presented herewith constitute the third contribution from the Entomological Laboratory of this University (Stanford) to the knowledge of the North American Mallophaga. The two previous papers are respectively, Kellogg, New Mallophaga, I, 1896¹ and Kellogg, New Mallophaga, II, 1896¹ and contain in addition to descriptions of species, an introduction to the study of the group, comprising keys to genera, terminology, bibliography, etc.

Mr. Snodgrass's paper presents the results of the first serious attempt to study comparatively the anatomy of these insects. There is yet needed to make the Mallophaga fairly known a study of their embryonic and post-embryonic life-history. It is hoped that this study can soon be undertaken.

Types of the new species described will be placed in the collections of this University, in the collections of the California Academy of Sciences, and in the collections of the University of Kansas. The authors have to express their obligations for services kindly rendered in connection with the preparation of this paper to Mr. Leverett M. Loomis, Curator of the Department of Ornithology, California Academy of Sciences, to Messrs. R. C. McGregor, J. F. Abbott, Cloudsley Rutter, A. W. Greeley, W. H. Osgood, J. C. Brown, R. C. McLain, R. W. Doane and E. M. Ehrhorn, to Prof. Walter E. Miller and to Miss Mary H. Wellman, artist.

V. L. K.

STANFORD UNIVERSITY,
April 15, 1897.

¹ Proc. Cal. Acad. Sci., 2nd Ser., Vol. VI.

MALLOPHAGA FROM BIRDS OF PANAMA, BAJA CALIFORNIA, AND ALASKA.

(With Plates I-IV.)

BY VERNON L. KELLOGG.

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Introduction.

Descriptions of New Species, and Identifications of Old Species.

Docophorus.

Nirmus.

Lipeurus.

Goniodes.

Eurymetopus.

Trinoton.

Colpocephalum.

Menopon.

Physostomum.

List of Hosts, with Parasites.

INTRODUCTION.

The Mallophaga described and identified in this paper were collected by Mr. R. C. McGregor (from the Panama birds), by Mr. J. F. Abbott (from the Baja Californian birds) and by Messrs. Cloudsley Rutter and A. W. Greeley (from the Alaskan birds), all these collectors being students of Stanford University. The birds in each case were obtained personally by the collector, and the Mallophaga taken from the freshly killed specimens or newly made skins. The determinations of the Panama birds were made by Mr. Robert Ridgway, curator of birds, U. S. National Museum; the determinations of the Baja Californian birds by Mr. W. W. Price, student of Stanford University, and the determinations of the Alaskan birds by the collectors.

The sequence of genera in the following paper does not indicate the author's views with regard to the natural relationships of these genera, nor even with regard to the phyletic rank of the suborders. The Amblycerous genera, coming last in the present arrangement, are undoubtedly the more generalized of the two subordinal groups. The sequence is that adopted in the European monographs and followed by me in my two previous papers (New Mallophaga, I, 1896, and New Mallophaga, II, 1896), and is retained for the sake of uniformity. The sequence of the species of each genus is determined by the host, the sequence of hosts being that adopted in the Check-List of North American Birds (2nd Edition, 1895), published by the American Ornithologists' Union. The names of the hosts are those used in the Check-List.

Wherever a species of Mallophaga is met, which has been previously identified by me on an American host, reference is made only to this previous identification, where the synonymy, European hosts, and figure and measurements of the species are given.

Docophorus.

Docophorous lari Denny. (See Kellogg, New Mallophaga, I, 1896, p. 98, pl. iv, fig. 4.)

Specimens from *Larus* sp. (Baja California) and from *Larus glaucescens* (North Pacific Ocean, off Alaska). Taken previously by me from several species of *Larus* (Bay of Monterey, California.)

Docophorus icterodes Nitzsch. (See Kellogg, New Mallophaga, I, 1896, p. 96, pl. iv, fig. 1).

Specimens from the Red-crested Merganser, *Merganser serrator* (Kodiak Island, Alaska). Previously taken by me from same host species and from seven other duck species (Kansas and California).

Docophorus cordiceps Giebel. (Plate I, fig. 2).

Insecta Epizoa, 1874, p. 103.

Docophorus glareolæ Giebel, Zeitschr. f. ges. Naturwiss., 1866, vol. xxviii, p. 312.

Docophorus nitzschia Giebel, Zeitschr. f. ges. Naturwiss., 1866, vol. xxviii, p. 312.

Docophorus mollis, Nitzsch (ed. Giebel), Zeitschr. f. ges. Naturwiss. 1861, vol. xviii, p. 312.

Docophorus frater Giebel, Insecta Epizoa, 1874, p. 103.

Docophorus cordiceps Giebel, Piaget, Les Pediculines, 1880, p. 80 and p. 664, pl. vi, fig. 2; Picaglia, Pediculini dell' istituto anat.-zool. d. R. Univ. d. Modena, 1885, reprint, p. 11.

A male, a female and a young specimen which may be referred to this species from *Tringa macularia* (Panama), and a male from *Tringa* sp. (Baja California). It is probable that Denny's *D. cephalus* (Monograph. Anoplur. Brit., p. 81, pl. ii, fig. 8; and Grube, Middendorff's Reise, 1851, p. 470) is this species.

The species may be recognized by its general dark coloration, broad head, short clypeus, and prominent and characteristic genitalia. I figure the male; Piaget has figured the female. The measurements of my specimens are as follows: male, body, length 1.6 mm., width .72 mm.; head, length .56 mm., width .62 mm.; female, body, length 1.65 mm., width .87 mm.; head, length .62 mm., width .75 mm.

Docophorus latifrons Nitzsch. (Plate I, figs. 5 and 8).

German's Mag. Entomol., 1818, vol. iii, p. 290.

Pediculus cuculi Fabricius, Syst. Ent., 1775, p. 807.

Pediculus fasciatus Scopoli, Entomol. Carniol, 1763, p. 383.

Docophorus latifrons N., Denny, Monograph. Anoplur. Brit., 1842, p. 97, pl. i, fig. 4; Giebel, Insecta Epizoa, 1874, p. 93; Piaget, Les Pediculines, 1880, p. 36, pl. ii, fig. 7.

Numerous specimens from a California Cuckoo, *Coccyzus americanus occidentalis* (Baja California), which are referable to this long-known *Docophorus* of the cuckoos, but on account of the markedly larger size, color differences, and other minor differences must be given a varietal name.

Var. *occidentalis* Kellogg. Male, body, length 2.06 mm., width .89 mm.; head, length .75 mm., width .75 mm. Female, body, length 2.5 mm., width 1.12 mm.; head, length .84 mm., width .85 mm. Piaget gives the following dimensions for *latifrons*: female, body, length 1.9 mm., width, .85 mm.; head, length .65 mm., width .6 mm. The male *latifrons* is 1.6 mm. long. My specimens have two long hairs on the temporal margins instead of one as described for *latifrons*, and have a distinct hair, not referred to in the descriptions of *latifrons*, in the posterior angles of the prothorax. The blotches on the ventral aspect of the abdomen of the males are with my specimens not oval, but transversely elongate, differing markedly from those of the female. The head and thorax of var. *occidentalis* are reddish brown, the ground color of the abdomen whitish, and the blotches blackish brown.

Docophorus californiensis Kellogg.

New Mallophaga, II, 1896, p. 483, pl. lxvi, fig. 6.

Eleven specimens from a Narrow-fronted Woodpecker, *Melanerpes formicivorus angustifrons* (Baja California). Type specimens taken from the Californian Woodpecker, *Melanerpes formicivorus bairdi* (Palo Alto, California).

Docophorus rufus n. sp. (Plate I, figs. 6 and 9).

A dozen specimens from the Ash-throated Flycatcher, *Myiarchus cinerascens nuttingi* (Baja California). A member, probably, of the group *femorati* of which *communis* is the chief representative. I have not found on my specimens the characteristic longish hair rising vertically from the dorsal surface of the anterior angles of the clypeus, but the broad clypeus, signature, genital blotches, and pustulated lateral abdominal blotches are of the *femorati* type. The species differs distinctly from *communis* in color, in the peculiar anterior convexity of the clypeus, in the extent of the transverse abdominal blotches, in the presence of transverse median blotches on the ventral aspect of the abdomen, and in the character of the genital blotches.

Description of the male. Body, length 1.56 mm., width .31 mm.; reddish brown, lighter on head and thorax, because the darker lateral abdominal blotches nearly cover the abdomen; broad headed; with ventral median transverse blotches on abdomen.

Head, length .5 mm., width .48 mm.; forehead broad, with expanded frontal uncolored part of clypeus flatly convex, with a shallow, median, curving emargination; no hairs on this frontal margin; sides of forehead with a pair of short hairs and a shorter single one in front of and near the trabeculae; the trabeculae very large, acute; antennae when projected backward not quite reaching the occipital margin; the inconspicuous, slightly pendulous eyes with a hair, and two hairs on the flatly convex temporal margin; occipital margin nearly straight, bare; color, reddish brown; signature large, broad, anterior margin almost straight, the dark, sharp posterior point projecting beyond the mandibles;

antennal bands interrupted distinctly at the suture; occipital bands distinct, divergent, connected at base; ocular bands indistinct; trabeculae weakly colored at base, uncolored distally; antennae colored.

Prothorax quadrangular (as exposed), with a single hair in the posterior angles; posterior margin flatly convex; median part paler; lateral regions darker, and an indistinct posterior border. Metathorax rather short, posterior margin angulated, with a series of pustulated hairs; colored like the prothorax, paler in middle and with fairly distinct lateral borders. Legs concolorous with ground color of thorax, with small, darker, inconspicuous marginal markings. Sternal markings consisting of intercoxal lines and a very small median double blotch on prothorax. (Metathorax obscure).

Abdomen short, just as long as head and thorax; two to three long hairs in posterior angles of segments and numerous pustulated and other long hairs on dorsal surface; narrow, blackish, lateral bands; large dark brown lateral blotch, with clear stigmal spots and about five pustulations along posterior margin, and leaving only a narrow median part of the abdomen uncovered; on segment 8 a complete transverse band; segment 9 rounded behind, with a narrow blackish posterior border, with a few longish hairs; genitalia showing through in segments 6-9; on ventral surface of segments 1-8 a large transverse median blotch reaching almost to the lateral margins.

Female. Body, length 1.94 mm., width .8 mm.; head, length .6 mm., width .56 mm.; the transverse blotches of abdomen but little smaller than those of male; segment 9 uncolored, with small brown lateral blotches, the posterior margin distinctly angularly emarginated;

ventral abdominal blotches smaller than those of male and not reaching so far laterally, those of posterior segments forming a genital blotch with broad, curving anterior part, narrower median part, and separate small lateral reniform parts.

Docophorus communis Nitzsch. (See Kellogg, New Mallophaga, II, 1896, p. 486, pl. lxvi, fig. 7).

Several specimens from the Saint Lucas Cardinal, *Cardinalis cardinalis igneus* (Baja California). Taken previously by me from 16 species of passerine birds (Kansas and California).

Docophorus panamensis n. sp. (Plate I, fig. 1).

From a tanagrine bird, *Phænicothraupis fuscicauda* (Panama). A *Nirmus*-like form but with distinctly long trabeculæ. By shape of head and thorax allied to the *angustifrontes* group of the woodpeckers; resembling my *D. jungens* (New Mallophaga, II, 1896, p. 481, pl. lxvi, fig. 4) from *Colaptes auratus* (Kansas).

Description of female. Body, length 1.75 mm., width .61 mm.; narrow, Nirmoid, whitish with distinct brown lateral bands on thorax and abdomen, and quadrangular lateral transverse blotches.

Head, length .5 mm., width .5 mm.; triangular, with narrow front, slightly emarginated; three short hairs on each side of the anterior half of the forehead, and three longer hairs and a prickle in front of the trabeculæ; the trabeculæ prominent, extending beyond the tip of first segment of the antennæ; the antennæ rather thick, segment 2 longest, with a prominent short spiny hair; eyes rather large, with a prickle; temporal margin

rounding, with one long hair and a few prickles; occipital margin slightly sinuous; forehead whitish with narrow brown antennal bands terminating at the suture; a palely colored broad suture with straight posterior margin and emarginated anterior border; whole hind head light brown with occipital margin very narrowly bordered with blackish brown.

Prothorax quadrangular, posterior angles rounded, with one hair, posterior margin flatly convex; whitish with dark brown lateral borders extending inward along the posterior margin. Metathorax angulated on abdomen, each latero-posterior side with nine long hairs (including the one in the lateral angle); lateral borders unevenly blackish brown; ground color of segment whitish tinged posteriorly with light brown, this posterior coloration interrupted by a median longitudinal whitish line. Legs very pale brown. Sternal markings consisting of distinct intercoxal lines, and faint traces of light brown median blotches.

Abdomen elongate-elliptical; a few longish hairs in posterior angles, and numerous weak long hairs on dorsal surface of segments in transverse series; ground color whitish with distinct, narrow lateral bands, darkest on anterior segments, and light brown, quadrangular, transverse lateral blotches on all segments, the two blotches of segment 8 meeting on the median line; segment 9 feebly emarginate, with no hairs on the posterior margin.

Docophorus domesticus Kellogg.

New Mallophaga, II, 1896, p. 475, pl. lxx, fig. 4.

A female and an immature specimen from the Black Martin, *Progne subis hesperus* (Baja California). De-

scribed from a Purple Martin, *Progne subis* (Lawrence, Kansas).

Docophorus laticeps Giebel. (Plate I, figs. 4 and 7).

Insecta Epizoa, 1874, p. 88.

Philopterus cincli Gervais, Hist. nat. d. Insectes aptères, 1847, p. 336.

Docophorus cincli Denny, Monograph. Anoplur. Brit., 1842, p. 85, pl. v, fig. 8.

Docophorus laticeps Giebel, Piaget, Les Pediculines, 1880, p. 65; Koenig; Ein Beitrag zur Mallophagen-fauna, 1884, p. 3, pl. i, figs. 1-5; pl. ii, figs. 6, 7.

One adult female and two immature specimens from the American Dipper, *Cinclus mexicanus* (Kodiak Island, Alaska), which may be referred to this species, but which constitute a distinct variety characterized by the elongate, slender forehead with emarginated front. The species was found on *Cinclus aquaticus*, the European Dipper.

Var. *americanus* Kellogg. Female, body, length 2.06 mm., width .75 mm.; head, length .6 mm., width .5 mm.; thus being one-third longer than the species dimensions as given by Koenig; head elongate, with narrow tapering forehead; front uncolored, with slight, narrowly rounded emargination; signature long, narrow, with posterior point reaching the mandibles; antennal bands distinct; trabeculae long, slender; abdomen elongate-elliptical, with lateral triangular blotches with stigmatal spots and pustulations as in the species types; also, narrow blackish lateral bands; segment 8 wholly colored; ventral surface of abdomen with transverse median blotches; segment 7 with a narrower median blotch (touching blotch of segment 6) and two small lateral reniform blotches; segment 8 wholly colored or nearly so.

Docophorus rutteri n. sp. (Plate I, fig. 3).

A female and an immature specimen from an Oregon Chickadee, *Parus atricapillus occidentalis* (Kodiak Island, Alaska). Denny has described two species of *Docophorus* from *Parus*, one, *pallescent* (Monograph. Anoplur. Brit., p. 82, pl. i, fig. 8) from *Parus palustris* and *P. major*, being based on immature specimens, and characterized by an emarginate clypeal front; the other, *pari* (ibid, p. 87, pl. vi, fig. 6) from *Parus caudatus*, *P. ater*, and *P. caeruleus*, being of chestnut ground color, without lateral abdominal blotches and with a subacuminate head, and without series of pustuled hairs along posterior margins of metathorax, in all of which diagnostic characters my specimen differs from *pari*. It agrees with it in hairy abdomen, acute trabeculæ, angulated metathorax, and general shape of abdomen.

Description of female. Body, length 2. mm., width .91 mm.; well marked with smoky brown blotches with large conspicuous pustulations, and many long hairs on dorsal aspect of abdomen.

Head, length .53 mm., width .6 mm.; a specially stiff, spiny short hair in each anterior angle of the flatly convex front, a hair before the suture and two before the trabeculæ; the trabeculæ long, slender, and weakly curving; antennæ when projecting backward barely reaching the occipital margin, with annulated segments; eye rather prominent, with a hair; a hair just behind the eye and three more on the rounded temporal angles; occipital margin weakly sinuous, the middle third slightly convex; signature large, distinct, with darker posterior acuminate point projecting beyond the mandibles, surrounded by a nearly uncolored region; antennal bands interrupted, widening at base; occipital bands

distinct, blackish brown, diverging, and with anterior extremities reaching the blackish, distinct, curving, linear ocular blotches; region between the occipital bands pale; temples dark brown.

Prothorax small, short, margins rounding, with one long pustulated hair in posterior angle, another on posterior margin just a little inside of the angles, and four grouped together in the posterior median region of the segment; median region pale to uncolored, darkening laterally until the blackish lateral borders are reached. Metathorax roundly angulated on the abdomen; an unpustulated hair in the lateral angles and ten long hairs on each half of the posterior margin, rising from conspicuous pustulations; median region palest, lateral and posterior regions blackish brown, causing the clear pustulations to be very prominent. Legs smoky brown.

Abdomen oval; lateral angles projecting, with long hairs; dorsal surface of segments with single transverse series of long weak hairs; median region almost uncolored; prominent blackish brown, subtriangular, lateral, transverse blotches, with very conspicuous uncolored stigmatal spots and pustulations; segment 8 wholly colored, dark brown; segment 9 with small triangular lateral brown blotches; shallow, angular emargination behind.

Nirmus.

Nirmus punctatus Nitzsch. (See Kellogg, New Mallophaga, I, 1896, p. 109, pl. vi, figs. 1 and 2.)

Specimens from *Larus* sp. (Baja California). Taken previously by me from several species of *Larus* (Bay of Monterey, California).

Nirmus furvus Nitzsch. (Plate II, fig. 1).

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1866, vol. xxviii, p. 374.

Nirmus furvus N., Burmeister, Handb. d. Ent., 1832, vol. ii, p. 427; Giebel, Insecta Epizoa, 1874, p. 163, pl. v, figs. 2 and 3; Piaget, Les Pediculines, 1880, p. 169, pl. xiv, fig. 3; Supplement, 1885, p. 25; Osborn, Insects Affecting Domestic Animals, Bull. 5, N. S., Div. of Ent., U. S. Dept. Ag. 1896, p. 225.

A male and a female from the Spotted Sandpiper, *Actitis macularia* (Panama). My specimens do not possess the median longitudinal uncolored line across the first six or seven segments of the abdomen, as described for the types of the species, and besides, are very much darker, and are without distinct lateral transverse blotches on the abdominal segments. They are, too, a distinctly wider and less slender form, the head averaging nearly one-fifth wider in both sexes. However, in the present uncertain status of the species *furvus* (see Piaget, Les Pediculines, p. 170) I refer my specimens to the species, distinguishing them by a varietal name. Piaget's variety *alpha* (Supplement, p. 25) from *Vanellus cayensis* has, like my specimens, no uncolored median abdominal line, but no reference is made to any such characteristic dark chestnut to smoky general coloration of the body, as is shown by my specimens. Osborn's specimen is from *Phalaropus tricolor* (Museum Iowa Agricultural College).

Var. *ravus* Kellogg. Male, body, length 1.18 mm., width .34 mm.; head, length .37 mm., width .28 mm. Female, body, length 1.43 mm., width .37 mm.; head, length .40 mm., width .31 mm. Both sexes dark chestnut-brown to smoky, without median uncolored line on any abdominal segment, and without distinct abdominal blotches.

Nirmus fissus Nitzsch. (Plate II, fig. 2).

Germar's Mag. Entomol., 1818, vol. iii, p. 291.

Nirmus fissus N., Burmeister, Handb. d. Ent., 1835, vol. ii, p. 427;

Denny, Monograph. Anoplur. Brit., 1842, p. 148, pl. x, fig. 6;

Walckenaer, Ins. Apt., 1844, vol. iii, p. 344.

Nirmus bicuspis N., Giebel, Insecta Epizoa, 1874, p. 155, pl. v, figs.

11 and 12; Piaget, Les Pediculines, 1880, p. 184, pl. xv, fig. 7.

Several specimens, including male, female and immature specimens, from *Tringa* sp. (Baja California). My specimens are larger than the types of *bicuspis* and offer distinct though minor differences. I have given them a varietal name.

Var. *major* Kellogg. Measurements. Male, body, length 1.61 mm., width .38 mm.; head, length .3 mm., width .31 mm. Female, body, length 1.87 mm., width .44 mm.; head, length .47 mm., width .33 mm. Differs from types of *fissus* (which were taken from "*Charadrius minor*") by having a hair in the eye, by having four pustulated hairs on each lateral half of the posterior margin of the metathorax instead of three, two being median and two being near the angle; by having the median longitudinal uneolored line of the abdomen limited to the first two segments, and by being markedly larger. Piaget's specimens of *fissus* are: length, male, 1.3 mm. to 1.4 mm.; female, 1.5 mm.

Nirmus fuscus Nitzsch. (See Kellogg, New Mallophaga, II, 1896, p. 499, pl. lxvii, fig. 7).

Many specimens from a Sparrow Hawk, *Falco sparverius* (Panama), a Lower Californian Sparrow Hawk, *Falco sparverius peninsularis*, a Duck Hawk, *Falco peregrinus anatum*, and a Saint Lueas Redtail, *Buteo borealis lucusanus* (Baja California). Taken previously by me from three species of hawks at Lawrence, Kansas. The

size of these specimens from Panama and Baja Californian birds corresponds with that of the specimens previously taken by me from the Kansas birds, and is fully one-third greater than that recorded for the European specimens. The American specimens are at least varietally distinct from the typical Old World forms. There are variations manifest among the American specimens but I have not enough material yet to attempt to distinguish varieties.

Nirmus splendidus n. sp. (Plate II, figs. 3 and 6).

Males, females and young from a Caracara, *Polyborus cheriway* (Baja California). Species of *Docophorus*, *Lipeurus*, *Menopon*, and *Colpocephalum* have been taken from *Polyborus* by the European authors, but heretofore no *Nirmus*. The new species is unlike any of the *Nirmi* yet described from raptorial birds. It is large and strikingly marked.

Description of the male. Body, length 2.19 mm., width .84 mm.; large, broad-bodied, whitish with prominent lateral transverse brown abdominal blotches; head and thorax almost entirely colored.

Head, length .62 mm., width .6 mm.; forehead broad between trabeculæ and narrowly parabolic in front; forehead with four short separated hairs on each side; trabeculæ rather large for *Nirmus*, antennæ short; eye large, prominent, with a long hair, and with a fine prickle just behind it; temporal margins flatly convex, with two very long hairs; occipital margin straight; whole head strongly colored with exception of a pale, broad, clypeal, sutural line, and a short median longitudinal line leading from it backwards to the mandibles; the antennal bands narrow, and a little darker than

general color of head, running entirely around frontal margin of head, although paler and nearly "interrupted" at the clypeal suture; trabeculae nearly uncolored.

Prothorax short, oblong, with one hair in posterior angles; segment almost wholly colored. Metathorax short, the whole thorax being little more than one-half the length of the head; obtusely angulated on abdomen; posterior margin with a series of long hairs; segment mostly colored, darkest in median region; a broad white posterior border. Sternal markings consisting of inconspicuous intercoxal lines, and a small, indistinct median blotch on metathorax. Legs pale, though tinged with brown, with distinct, dark brown marginal markings.

Abdomen ovate; posterior angles of segments 1 and 2 without hairs, of segment 3 with a single hair, and of succeeding segments with two hairs; dorsal surface with numerous longish hairs; whitish with distinct lateral transverse blotches, each, with a clear stigmatal spot and some pustulations on segments 1-7; segment 8 with a curving, continuous brown transverse blotch; segment 9 rounded behind, with numerous longish hairs; uncolored except where the chitinized genitalia show through. Ventral surface all whitish except for a well defined and characteristic brown genital blotch on segments 7-9 (see fig. 6, pl. ii).

Female. Body, length 2.37 mm., width .97 mm.; head, length .62 mm., width .62 mm.; the increased size of the female is due to the larger abdomen, the head and thorax being of about the same size in both sexes; lateral abdominal blotches are not so long as in the male; segment 9 is shorter, bears two small blotches, and is slightly emarginated behind.

Nirmus atopus n. sp. (Plate II, fig. 4).

From a bird of the cuckoo family (Cuculidæ), *Piaya cayana thermophila* (Panama). This new form is one of the circumfasciate *Nirmi* of the general character of Rudow's *alchatae* (Piaget, Les Pediculines, p. 165, pl. xiii, fig. 12) and allied forms. The few described members of this group have been found on columbine and gallinaceous birds.

Description of female. Body, length 1.84 mm., width .63 mm.; abdomen expanding posteriorly to segment 6; pale brownish white with brown lateral abdominal and thoracic bands and circumfasciate head.

Head, length .59 mm., width .53 mm.; forehead broad, rounded in front, with very few very fine hairs on the margin; trabeculae small but distinct, acute; antennae slender, with segment 5 longer than segments 3 or 4; temples rounded, with two long hairs and two or three very fine prickles on margins; eye without a hair, not especially prominent; occipital margin straight, bare; ground color of head whitish with small, inconspicuous brown ocular blotches, temples very narrowly margined with brown, and rather broad chitin band, subtranslucent brownish along the entire front and lateral margins of forehead, and ending posteriorly in small elliptical expansions directed diagonally inwards.

Prothorax very short, quadrangular; lateral margins straight; posterior angles rounded, with one long hair; posterior margin straight; lateral borders brownish, the coloring extending along the posterior margin of the segment. Metathorax pentagonal, lateral margins bare, posterior margin obtusely angled on abdomen, with one hair in latero-posterior angle and four pustulated hairs in two pairs, one pair almost in the latero-

posterior angle on each lateral half of the margin; lateral borders blackish brown, the color extending inward, but paling, in latero-posterior angles. Legs of pale ground color of the body, with narrow dark marginal markings. Sternal markings consisting of intercoxal lines, a small triangular blotch on mesothorax which fits like an apex to a larger pentagonal blotch on the metathorax.

Abdomen widening posteriorly to segment 6, then tapering bluntly; posterior segments with weak longish hairs in posterior angles; numerous weak, longish hairs on dorsal aspect in the broad median uncolored longitudinal line; lateral bands brown, distinct, extending posteriorly only through segment 7; pale brown, quadrangular, lateral, transverse blotches; last segment convex behind, with a very slight median emargination.

Nirmus virgatus n. sp. (Plate II. fig. 5).

Males and females from an icterine bird, *Amblycercus holosericeus* (Panama). Much like *N. illustris* Kellogg (New Mallophaga, II, p. 494, pl. lxvii, fig. 4), from the Red-winged Blackbird, *Agelaius phoeniceus* (Lawrence, Kansas), and like *ornatissimus* Giebel (Insecta Epizoa, p. 144). The new form has a narrower front with the anterior angles not rounded, and does not possess the distinct bands internal to the antennal bands of the head of *illustris*. The lateral bands of the abdomen are wider, and the lateral transverse abdominal blotches are much more clearly indicated.

Description of male. Body, length 1.28 mm., width .47 mm.; whitish with striking broad black lateral borders of thorax and abdomen, black antennal and ocular bands, chestnut-brown outlines of transverse,

lateral abdominal blotches on dorsal aspect, and chestnut-brown transverse median blotches on ventral aspect of abdomen.

Head, length .37 mm., width .37 mm.; front truncate or with a very shallow concavity; a few small hairs on sides of forehead; trabeculae long; antennae slender, segment 5 distinctly longer than either segments 3 or 4; eye distinct, slightly pendulous; temples not much expanded, margins flatly rounded, with one long hair and a few prickles; occipital margin straight; ground color whitish to uncolored; broad black antennal bands running to anterior angles of head and bending in angularly at base of trabeculae; rest of forehead and trabeculae uncolored; no colored clypeal signature; antennae with segment 1 uncolored, other segments entirely blackish brown; ocular bands narrow, blackish; anterior part of temporal margins narrowly blackish; a brown, shield-shaped occipital signature showing through; mandibles and oesophageal sclerite showing through, brown.

Prothorax quadrangular, with rounded posterior angles with one hair in angle; segment whitish with broad lateral blackish brown borders. Metathorax angulated on abdomen; lateral angles obtuse; five long hairs on each latero-posterior margin; segment whitish, with uneven broad blackish lateral borders. Legs whitish with blackish brown blotches and semiannulations. Sternal markings consisting of distinct, chestnut-brown intercoxal lines, with expanded inner ends touching a small median blotch.

Abdomen elongate-ovate, with not very long hairs in posterior angles, and two hairs on the posterior margin of the dorsal aspect of each segment; ground color clear to whitish; broad lateral bands, from which project inwards the outlines of lateral transverse blotches which

are oblong on segments 2-6, and tapering on segments 7-8; on the ventral aspect each segment has a chestnut-brown median blotch which shows through above; segments 8 and 9 are narrow; segment 9 projects narrowly backward, is narrowly but flatly rounded behind, and is mostly colored.

Female. Body, length 1.5 mm., width .53 mm.; head, length .41 mm., width .43 mm.; the head is a little wider in proportion to its length than in the male; last segment with distinct triangular lateral blotches and angularly emarginated behind.

Nirmus peninsularis n. sp. (Plate II, fig. 9).

Numerous specimens from a Phainopepla, *Phainopepla nitens* (Baja California). A member of the difficult group *interrupto-fasciati*, to which belongs my species *vulgatus* (New Mallophaga, II, p. 496, pl. lxvii, fig. 5), from seven passerine species, *simplex* (l.c., p. 492, pl. lxvii, fig. 2) from the Robin, *Merula migratoria*, and the strongly marked species *eustigmus* (l.c., p. 493, pl. lxvii, fig. 3) from Anna's Humming-bird, *Trochilus annæ*. The species from *Phainopepla* resembles most closely *brachythorax* Giebel (Insecta Epizoa, p. 134) from *Ampelis cedrorum*.

Description of female. Body, length 1.86 mm., width .41 mm.; long, slender, pale, with narrow marginal markings on head and intercoxal lines showing through on thorax.

Head, length .37 mm., width .31 mm.; elongate-triangular, with bluntly rounded apex; marginal hairs of forehead inconspicuous; trabeeculae small, uncolored but distinct; antennae when projected backward reaching the occipital margin of head; eye not prominent, with a prickle; temples straight, with a single long hair in

obtuse angle between temporal and occipital margin; occipital margin very flatly convex, ground color whitish; a blackish brown narrow lateral border on temples and forehead, this border turning in angularly at antennal fossa; front of clypeus uncolored and an indistinct, uncolored elongate-oval fossa widening posteriorly; mandibles and oesophageal sclerite showing through pale brown; no occipital border.

Prothorax quadrangular, with slightly convex, lateral and posterior margins; posterior angles with one small hair; ground color whitish, a blackish brown blotch in anterior angles, and posterior margin weakly bordered by the intercoxal lines of ventral surface showing through. Metathorax in outline a semicircle with anterior curving part slightly flattened and posterior margin slightly convex; posterior angles with three long pustulated hairs and three shorter, weaker, non-pustulated ones; one of the long hairs is in the apex of the angle, the other hairs are ranged along the posterior margin near the angle; segment whitish with darker anterior marginal markings. Sternal markings consisting of distinct intercoxal lines. Legs concolorous with thorax, with dark brown dorsal marginal markings.

Abdomen elongate, subparallel sided; segments 1 and 2 without hairs in posterior angles, segments 3-6 with one to two short, weak hairs in angles; segment 7 with three hairs in angles, and segments 8 and 9 with a few weak, curving hairs; segment 9 very short, with slight emargination; segments 5 and 6 with a hair on dorsal surface on each side rising from the posterior margin of segment just inward from the lateral band; dorsal surface otherwise naked; color of abdomen whitish, with narrow translucent lateral bands, each segmental portion passing the suture anteriorly.

Male. Body, length 1.34 mm., width .37 mm.; head, length .33 mm., width .26 mm.; being thus markedly shorter than the female; abdomen widening distinctly posteriorly, so that segment 5, which is widest, is more than one and one-half times as wide as segment 1; segment 8 short and much contracted within segment 7; segment 9 truncate behind; the genitalia showing indistinctly through segments 7-9; an indistinct, median pale brownish coloring on all segments.

Nirmus interpositus n. sp. (Plate II, fig. 7).

Three females from Vieillot's Warbler, *Dendroica bryanti* (Panama). A member of the group *interrupto-fasciati*, intermediate in markings between *N. vulgaris* Kellogg (New Mallophaga, II, p. 496, pl. lxvii, fig. 5), from several passerine birds from California and Kansas, and *eustigmus* Kellogg (l.c., p. 493, pl. lxvii, fig. 3), from *Trochilus annæ*, California. In size the new species is shorter than *vulgaris* but of the same width, and is both shorter and narrower than *eustigmus*. In general outline of body it resembles *eustigmus* more than *vulgaris*, but differs from *eustigmus* in having the sixth abdominal segment widest instead of the fourth.

Description of the female. Body, length 1.41 mm., width .41 mm.; whitish with distinct, broad, black, lateral abdominal bands and thoracic borders; head nearly equilaterally triangular.

Head, length .31 mm., width .34 mm.; outline of head nearly that of an equilateral triangle; the lateral margins of the head are weakly convex outward and the apex is parabolically curved; there are five or six short, inconspicuous hairs on each lateral margin of the forehead; the trabeculæ extend to the end of the

first antennal segment and are uncolored; eye with a prickle; temporal margins with one long hair in the apex of the rounded, nearly right angle; occipital margin bare, very flatly convex; ground color whitish with a faint golden brown tinge; forehead and temporal margins narrowly bordered with blackish brown; front of clypeus uncolored; antennæ uncolored; occipital margin not bordered or only very narrowly and indistinctly so, an indistinct, pale brown, shield-shaped occipital signature showing through.

Prothorax very short, widely rectangular; a single longish hair in posterior angles; color whitish, with the intercoxal lines of under side showing through, and distinct blackish brown lateral borders. Metathorax short, lateral margins bare, sinuous; posterior margin flatly convex, with six or seven longish hairs on each half beginning in the posterior angle; whitish, with an uneven, blackish brown lateral border, and the strongly colored intercoxal lines of underside showing through. Legs whitish with blackish brown dorsal marginal markings. Sternal markings consisting of distinct intercoxal lines and indistinct pale median blotches.

Abdomen narrowest anteriorly, widening posteriorly to segment 4; segments 4-6 about same width, segment 7 slightly narrower, segments 8 and 9 short; short, weak single hairs in posterior angles of segments 3-7, with one or two shorter, weaker hairs in segments 5-7; dorsal surface with no or very inconspicuous hairs; whitish with distinct, rather broad, blackish brown lateral bands on segments 1-7, the segmental parts of the bands passing the suture and separated by nearly uncolored narrow spaces; covering the middle region of segments 6-7 a large, pale brown, shield-shaped blotch; segment

8 with a transverse blotch, pale brown, darker outwardly, and behind not reaching the lateral margins; segment 9 with two very small pale brown linear lateral blotches, and feebly emarginated behind.

Nirmus audax n. sp. (Plate II, fig. 8).

From the yellow-headed Tit, *Auriparus flaviceps* (Baja California). A member of the group *interrupto-fasciati*, of darker ground color and with much more pronounced abdominal blotches than is usual in this group (see *vulgatus* Kellogg. New Mallophaga, II, 1896, p. 496, pl. lxvii, fig. 5).

Description of female. Body, length 1.6 mm., width .58 mm.; rather short and broad for *Nirmus*, especially of the *interrupto-fasciati* type; brownish ground with dark lateral blotches on thorax and abdomen, and blackish lateral bands and marginal markings.

Head, length .38 mm., width .41 mm.; the outline being nearly that of an equilateral triangle with blunted and curving apex and slightly convex legs; the marginal hairs of the forehead are few and very small; trabeculae distinct, uncolored; temporal margins with a long hair in the rounded angle and several prickles; occipital margin weakly concave laterally and weakly convex in the middle; anterior part of forehead with nearly uncolored ground, with two brownish linear blotches bounding the oval fossa laterally; rest of head brownish with darker lateral borders and suggestions of occipital and ocular bands; antennae colored.

Prothorax short, rectangular, with a single hair in posterior angles; color pale brownish in the middle, with the lateral regions dark brown, darkest on lateral margins. Metathorax angulated behind, with several strong hairs along each latero-posterior margin; latero-

anterior margins bare, convex. Color brownish, paler in middle, stronger laterally and posteriorly, with uneven, blackish latero-anterior borders, and latero-posterior borders nearly uncolored. Legs brown with paler regions at extremities of segments and blackish dorsal margins, sternal markings consisting of distinct intercoxal lines, those between pro- and mesocoxæ with angulated spurs nearly touching; between the metacoxal lines a median blotch.

Abdomen short and broad, in shape an ellipse, segment 4 being the widest; ground color very pale brownish; segments 1-7 with narrow black lateral bands, the segmental parts distinct and passing the suture; quadrangular brown lateral blotches darkest internally on segments 1-7; segment 8 wholly colored; segment 9 uncolored and weakly emarginate behind; ventral surface of segments with a brown median blotch, the blotches of segments 6-7 fusing.

Lipeurus.

Lipeurus confidens n. sp. (Plate III, fig. 1).

Four females from a Black-footed Albatross, *Diomedea nigripes* (North Pacific Ocean). A species which in outline of body, color and markings is very like Piaget's species *tricolor* (Les Pediculines, p. 363, pl. xxx, fig. 4) from *Diomedea fuliginosa* (collection in the Museum of Leyden), but which is one and one-third times as large, without circumfasciate antennal bands, without occipital bands, with metathorax not without hairs as described for *tricolor* but with longish hairs in the posterior angles, without median abdominal blotches, and with last segment of female not acutely but bluntly two-pointed.

Description of female: Body, length 4.13 mm., width 1.03 mm.; large, whitish with sharply defined, black marginal markings, the lateral abdominal bands consisting of segmental pairs of contiguous subtriangular blotches.

Head, length .81 mm., width .7 mm.; subtriangular, widest just behind the eyes; front parabolic, with uncolored margin without hairs; a longish hair at the suture, with three in front of it (the foremost the longest) and two behind it on each side of the forehead; antennæ rather elongate, slender, segment 1 large and as long as segment 2; anterior angles of antennary fossæ acute but projecting little; the fossæ shallow; eyes prominent; temporal margins most convex just behind the eyes, obtusely angulated behind, and bearing a single weak hair and a few short spines; occipital margin nearly straight, bare; ground color whitish; strong, blackish brown antennal bands interrupted at the suture, widening posteriorly and extending back as far as the eye; two triangular blotches on occipital margins appearing as pointed continuations of the lateral bands of prothorax; antennæ uncolored.

Prothorax, as exposed, short, quadrangular, with flatly convex posterior margin and a longish spine in each posterior angle; color whitish, with even, strong, blackish lateral borders, turning in for a little distance at posterior angles. Metathorax with lateral concavities and five hairs in posterior angles, four of these hairs being long, strong, colored, and set closely together in a small uncolored space; posterior margin straight or even slightly concave; segment whitish with uneven, broad lateral borders, widest in middle and not reaching the posterior angles. Legs uncolored except for the chestnut-brown tarsi. No sternal markings.

Abdomen, fourth segment widest; segments of about equal length; posterior angles with few weak, not long, hairs; color whitish, with very narrow, clear lateral margin which sends expanded processes inward, three in each segment; the foremost of the three is the smallest and is contiguous to the suture; the hinder two are covered by two triangular blackish blotches which on some segments are contiguous, on others distinctly separate; segments 8 and 9 narrow, colored laterally; posterior margin of segment 9 truncate, with a very small angular emargination; two short hairs on each of the blunt points.

***Lipeurus densus* Kellogg.** (Plate III, fig. 2).

New Mallophaga, I, 1896, p. 114, pl. vii, figs. 1 and 2.

A single male from a Black-footed Albatross, *Diomedea nigripes* (North Pacific Ocean, off Alaska). This specimen is a full millimeter longer and is much more completely blotched with dark brown than the original type specimen, a female; but I think they are of the same species. The female described is undoubtedly not fully grown and colored. While the antennæ vary in the sexes, that of the male bears no projection: it is simply heavier and larger, with its first segment largest; in the female, segment 3 is the longest. It is a male of this species, probably, which Tasehenberg (Die Mallophagen, 1882, p. 145, pl. v, fig. 1a) describes and figures as the female of *ferox*.

Description of male. Body, length 5.8 mm., width 1.25 mm.; ground color very pale brown, but body mostly covered by large, dark brown blotches, head and thorax slightly longer than abdomen.

Head, length 1.3 mm., width 1.06 mm.; front parabolic, with a group of three distinct hairs at each side

and two or three shorter ones along margin in front of antennary fossæ; antennæ large, long, (almost 1 mm.), without projection on any segment; segment 1 largest and other segments successively decreasing in width and length, uncolored except for an indefinite brownish annulation on segment 2; eyes projecting, conspicuous; temporal margins slightly expanded, rounded behind, with one short, weak hair and a few prickles; ground color brownish white; even, blackish brown antennal bands running around in front, the small portion of elypeus lying in front of the band being dark subtranslucent brown; temporal regions bounded within by diverging occipital bands, all blackish brown, these blotches acutely pointed in front and almost reaching to, but distinctly separate from, the bases of the antennal bands; on the forehead a dark brown lateral blotch on each side and in front of the mandibles.

Prothorax short and quadrangular as exposed; two short, weak hairs in posterior angles, one lying in on posterior margin; narrow median region of segment whitish, widest behind; lateral portions of segment blackish brown, paling inwardly. Metathorax large, long, with lateral margins concave, posterior margin weakly and flatly concave; a single short, weak hair in the apex of the posterior angles, and five longer, stronger, light brown hairs in a very small elongate-elliptical, uncolored space near the apex of the angles; segments all blackish brown, except a whitish, bluntly pointed, arrow-head-shaped, median region; projecting laterally from the posterior tip of this whitish space is on each side a small, linear, whitish space. Legs long, strong, coxæ nearly uncolored; femora dark brown, with uncolored extremities and tibiæ mostly colored. Sternal markings, prosternum with narrow, pericoxal

lines; mesosternum with a rather large, brownish, median blotch; metasternum with weak indications of a median blotch.

Abdomen short, nowhere broader than thorax, with subparallel sides until segment 7 is reached, when the posterior tapering is begun; segments 1-6 of about equal size; segment 7 longer than others; segments 8-10 successively narrower and shorter; an uncolored median longitudinal line extending whole length of abdomen, rest of surface colored blackish brown by large quadrangular lateral blotches, which have clear stigmatal spots and are palest along inner margin; last segment angularly emarginated, with three short hairs on each point; segments 1-4 with a single very short hair in each posterior angle, segments 5-9 with longer hairs.

Lipeurus forficulatus Nitzsch. (See Kellogg, New Mallophaga, I, 1896, pl. ix, figs. 3, 4, 5 and 6).

Many specimens from a Californian Brown Pelican, *Pelecanus californicus* (Baja California). Taken previously by me from same host species (Bay of Monterey, California).

Lipeurus gracilicornis Piaget. (Plate III, fig. 3).

Les Pediculines, 1880, p. 309, pl. xxv, fig. 6.

Many specimens including males, females, and young from a Man o'War Bird, *Fregata aquila* (Panama). My specimens, to which I give a varietal name, differ from Piaget's types (taken from *Fregata minor*), as described, in three important particulars, viz., character of antennæ, metathoracic hairs, and size. In other particulars the specimens from the two bird species agree well.

Var. *major* Kellogg. Measurements (Piaget's meas-

urements of the type specimens are in parentheses), male, body, length 3.12 mm. (2.5 mm.), width .37 mm. (.29 mm.); head, length .66 mm. (.58 mm.), width .39 mm. (.29 mm.) Female, body, length 3.10 mm. (2.4 mm.), width .69 mm. (.53 mm.); head, length .69 mm. (.63 mm.), width .50 mm. (.41 mm.) Distinctly larger than the types of the species; third segment of antenna of male with an appendage; metathorax with six long hairs, five together and one alone. I figure the female as Piaget has figured the male of the species type.

Lipeurus protervus n. sp. (Plate III, fig. 4).

Many specimens from a Willow Ptarmigan, *Lagopus lagopus* (Kodiak Island, North Pacific Ocean). On this Ptarmigan were some specimens of *Goniodes mammillatus* Rudow, found by me on the California Partridge, *Callipepla californica* (New Mallophaga, II, 1896, p. 509, pl. lxix fig. 2), but this *Lipeurus*, while of similar general character to *Lipeurus docophoroides* Piaget taken by me from *Callipepla californica* (New Mallophaga, II, 1896, p. 508, pl. lxviii, fig. 8), is distinctly of another species. The most readily noticeable difference is in the character of the lateral abdominal blotches, those of *docophoroides* leaving a comparatively wide, unblotched median region, while those of the new species leave but a narrow, median, unblotched line. The blotches of the first segment meet in the new species; they do not, even nearly, in *docophoroides*.

Description of female. Body, length 2 mm., width .72 mm.; short and broad, and sub-Docophoroid in form; whitish ground color with nearly completely colored head and thorax, and abdomen with large, lateral, quadrangular blotches.

Head, length .5 mm., width .5 mm.; front rounded,

with four very small, inconspicuous hairs on each side; trabeculae small, distinct, acute, uncolored; antennae rather short, segment 2 longest, segment 5 longer than 3 or 4, segments 4 and 5 colored, others uncolored or very weakly colored; eye large, with a hair; temples widest just behind the eyes; temporal margins converging posteriorly, nearly straight, with two long hairs and prickles; occipital margin concave; head pale brown in median region, temples, occipital border, and antennal bands with rim around the front, dark brown; a pale, almost uncolored transversal linear space in front of the mouth, and a similarly pale U-shaped space bounding the median region of the hind-head.

Prothorax small, short, quadrangular as exposed, with a single long hair in each rounded posterior angle; segment wholly brown except an uncolored posterior border. Metathorax small, not as long as broad, posterior margin obtusely angled on abdomen; two long pustulated hairs in a clear space on posterior margin near the lateral angles and two long pustulated hairs in a clear space on posterior margin midway between lateral angles and posterior angles; whole segment brown except a small, angular, median, whitish or uncolored space on anterior margin. Legs pale brown with narrow dark brown marginal markings. Sternal markings consisting of intercoxal lines and a shield-shaped median blotch on metasternum.

Abdomen elliptical, posterior angles of segments projecting slightly and with one to two longish weak hairs; ground color whitish with large quadrangular lateral brown blotches on segments 1-7, these blotches nearly meeting inwardly and separated intersegmentally by a whitish space about one-half as large as a blotch; the outer margins of the blotches are blackish,

forming narrow lateral bands; each blotch with a stigmatal spot, and a few (three or four) pustulations at inner end, in which are seated longish hairs; a long hair arises from a demi-pustulation on the posterior margin of each blotch just behind the stigmatal spot; segment 8 wholly colored and segment 9 nearly so; posterior margin of last segment minutely emarginated.

***Lipeurus macgregori* n. sp.** (Plate III, figs. 5 and 6.)

Numerous specimens from three individuals of the Ani, *Crotophaga sulcirostris* (Panama). This striking *Lipeurus* with its small Nirmoid body, and, except for the antennæ, Docophoroid head, shows no near resemblance to any other *Lipeurus* so far described.

Description of the male. Body, length 1.81 mm., width .56 mm.; short and broad for *Lipeurus*, Nirmoid in shape, head with slightly expanded anterior border of clypeus uncolored, and slightly emarginated as with many *Docophori*; ground color of body whitish with strong, dark brown, lateral borders of head, and lateral, transverse blotches of thorax and abdomen.

Head, length .53 mm., width .47 mm.; thus nearly as broad as long, triangular, with sinuate sides and truncated apex; anterior border of clypeus slightly expanded, uncolored, feebly emarginate; seven or eight distinct, rather long hairs on lateral margin; an angular concavity on lateral margin midway between trabecula and anterior angle; trabeculæ prominent; antennary fossæ deep; cyc prominent, almost pendulous, with a hair in it and a prickle just behind it; temporal margins convex, with three long hairs, a fourth one on occipital margin of temple; occipital margin sinuous, bare; antennæ long and large, segment 1 heavy, nearly as long as the rest of the segments together; segment

2 next largest and longest, segment 3 with simple appendage at distal extremity, segments 4 and 5 short, subequal; color whitish, with strongly colored, dark brown temples, angulated antennal bands, and lighter brown, distinct signature, pointed behind, straight in front; mandibles and œsophageal sclerite showing through dark brown; trabeculæ and antennæ paler smoky brown.

Prothorax short, quadrangular, wider than long, with one pustulated hair in posterior angle; a large, nearly square, dark brown, lateral transverse blotch nearly covering each lateral half of the segment, the broad, median line between them whitish. Metathorax short, but little longer than prothorax; posterior margin nearly straight, with five long pustulated hairs ranged along each lateral fourth, the inner two of the hairs may have only demi-pustulations. Sternal markings consisting of distinct, blackish brown intercoxal lines, and a pale brown, indistinct median blotch on metathorax. Legs pale smoky brown with darker margins and semiannulations.

Abdomen elongate-ovate; segment 1 conspicuously narrower than metathorax; one or two short hairs in posterior angles of anterior segments, two or three long hairs in angles of segments 5-9; ground color whitish with broad, dark brown, lateral, transverse blotches on segments 1-7, these blotches subquadrangular, but narrower inwards, and leaving only a broad, median, whitish, longitudinal line on middle of abdomen; in this whitish space a few longish hairs on each segment; rather large, uncolored, stigmatal spots in the transverse blotches of segments 2-7; the transverse blotch on segment 8 continuous across the segment and curving; segment 9 with two backward-projecting, short,

horn-like processes, dark brown, and a narrowly rounded, uncolored posterior border; genitalia extending through segments 6-9 and strongly chitinized.

Female. Body, length 2.41 mm., width .78 mm.; head, length .6 mm., width .53 mm.; considerably larger; abdomen more elongate; antennæ rather long, slender, segment 2 longest; lateral, transverse blotches of abdomen less tapering inwards; blotches of segment 8 distinct; segment conspicuously emarginate behind.

Goniodes.

Goniodes mammillatus Rudow. (See Kellogg, New Mallophaga, II, 1896, p. 509, pl. lxxix, fig. 2).

Specimens from the Ptarmigan, *Lagopus lagopus* (Kodiak Island, off Alaska). Previously taken by me from a Californian Partridge, *Callipepla californica* (Mountain View, California).

Eurymetopus.

Eurymetopus taurus Nitzsch. (See Kellogg, New Mallophaga I, 1896, p. 135, pl. xi, figs. 3, 4, 5 and 6).

Specimens from the Black-footed Albatross, *Diomedea nigripes* (North Pacific Ocean, off Alaska). Previously taken by me from *Diomedea albatrus* (Bay of Monterey, California).

Trinoton.

Trinoton luridum Nitzsch. (See Kellogg, New Mallophaga I, 1896, p. 152, pl. xiii, fig. 4).

Specimens from a Green-winged Teal, *Anas carolinensis* (Kodiak Island, off Alaska). Previously taken by me from same host species and six other duck species (Kansas and California).

Colpocephalum.

Colpocephalum abbotti n. sp. (Plate IV, fig. 9).

Taken from a gull, *Larus* sp. (Baja California). This new form is of the general type of *fuscipes* Piaget (Les Pediculines, p. 567, pl. xlvii, fig. 7) from *Larus dominicanus*, and of *funebre* Kellogg (New Mallophaga, I, p. 147, pl. xii, fig. 7) from *Larus glaucescens* (Bay of Monterey). It most nearly in general aspect, and especially in the branching, uncolored median line of abdomen, thorax, and head, resembles *sulcatum* Piaget (Les Pediculines, p. 565, pl. xlvii, fig. 5) from *Sterna nigra*, but is one-half larger, and has transverse series of hairs on the dorsal aspect of the abdomen, while *sulcatum* is here naked.

Description of female. Body, length 2.34 mm., width .88 mm.; rather large, long abdomen; abdomen sombre in color with narrow, black, lateral borders on hind head, thorax, and abdomen; a conspicuous, uncolored, median line on first five segments of abdomen, all of thorax, and hind head, the line dividing in the head and sending a branch to each lateral margin just in front of the ocular emargination.

Head, length .47 mm., width .7 mm.; front broad, very flatly convex, with numerous hairs of which four are longer than the others; on the lateral margins of the forehead in front of the ocular emargination a very long hair, with another shorter one close to it, and two in the angle; the palpi projecting beyond the lateral margins of the head; the ocular emargination deep, angular, with a prominent fringe and a longish hair rising just inward of the double eye; temples rather narrow, projecting, with four long hairs on the margin and one rising at some distance inward from the

occipital margin; six uncolored spots on the forehead, from two of which single long hairs arise and from the remaining four short hairs; occipital margin flatly concave, bare; head smoky brown with narrow black occipital border and curved ocular blotches; a broad, short-stemmed, uncolored Y, the prongs slightly angulated in the middle and terminating broadly in front of the eyes; the stem interrupts the black occipital border and is continuous with a median, uncolored, longitudinal line which traverses the thorax and the first few abdominal segments.

Prothorax broader than long, with obtuse lateral angles containing one longish hair and a spine in the apex of the angle, and a second longish hair arising from a little within and back of the apex; the latero-posterior margins bare, with a single longish hair in the slight angle which may be taken to separate the latero-posterior margin from the true posterior margin; two longish hairs on each half of the flatly convex posterior margin; color smoky brown with narrow black border on latero-posterior margins and on visible parts of latero-anterior margins; the small, slightly curving, longitudinal chitin bars at ends of the indistinct, usual transverse bar are black; the ground color of the segment is darker in posterior half, and the segment is bisected longitudinally by the median, uncolored line. Metathorax with a fairly distinct suture setting off the mesothorax; lateral margins bare; posterior angles with a hair and spines; posterior margin straight, with four weak hairs not on the very margin; color smoky brown with narrow black lateral borders. Legs slightly lighter than segments, and with ill-defined, darker marginal markings. Sternal markings distinct, a median shield on prothorax; a small, elongate, rather

cone-shaped median blotch on mesothorax, and a large, broadly diamond-shaped, median blotch on metathorax; intercoxal lines between pro- and mesothorax distinct.

Abdomen elongate-elliptical; segments with a single long weak hair and some short ones in posterior angles, and some short ones along lateral margins; a single transverse series of not very closely set weak hairs along posterior margin of each segment; general color light smoky brown with very narrow blackish lateral bands; last segment parabolic behind, with short hairs, and at each side a few longish hairs.

Colpocephalum spineum n. sp. (Plate IV, fig. 1).

A single male from a Man o'War Bird, *Fregata aquila* (Panama). Piaget has taken a small *Colpocephalum* from *Fregata minor* (*angulaticeps*, Les Pediculines, p. 569, pl. xlvii, fig. 8), to which this new form must show some resemblance in size and characteristic quadrangular shape of forehead; but the shape of the abdomen, not at all elliptical as described for *angulaticeps*, but elongate-oblong with nearly parallel sides, and the distinct and characteristic abdominal markings and lateral hairs of the prothorax, serve to make any reference of my specimen to *angulaticeps* impossible.

Description of male. Body, length 1.53 mm., width .44 mm.; elongate, narrow, with subparallel sides; pale golden brown with large dark brown head blotches and lateral brown blotches on abdomen.

Head, length .34 mm., width .47 mm.; forehead nearly quadrangular, with a few short hairs along the front and four short ones and two longish ones on sides; palpi and antennæ slightly projecting beyond the margin of the head; temples broad with flatly convex lat-

eral margins bearing numerous hairs of various lengths, two at least being long; occipital margin broadly concave; pale golden brown with broad blackish brown occipital border, greatly expanded triangularly at bases of the occipital bands; ocular blotches large, and a distinct blotch on each side of the front rami of the mandibles extending diagonally to the front margin.

Prothorax short, with a spine and longish hair in each lateral angle and four longish hairs and two spines along each lateral half of the posterior margin. Metathorax longer and wider than prothorax, almost as wide as abdomen; several spines in a double row along the lateral margins, some strong spines in the lateral angles, and a series of ten or twelve strong hairs along the nearly straight posterior margin, whole thorax of pale brown ground color of body. Legs concolorous with the thorax, with dark brown markings near distal extremity of femur and on tibiae. No distinct sternal markings.

Abdomen slender, elongate, with nearly parallel sides, with one long hair in posterior angles of segments 3-8 and numerous short hairs along lateral margins; dorsal surface covered with short spiny hairs, a series along the posterior margin of each segment being composed of longer but still spine-like hairs; color pale golden brown, the sutures whitish, and distinct subelliptical dark brown lateral blotches on segments 3-8, giving the abdomen a strikingly marked character; segment 9 but little narrower than segment 8 and broadly truncate behind; posterior margin with several long hairs and more shorter ones; dorsal surface with a transverse series of longish hairs.

Colpocephalum maculatum Piaget. (Plate IV, fig. 2).

Les Pediculines, 1880, p. 516, pl. xliii, fig. 1.

A male and a female from a Caracara, *Polyborus cheriway* (Baja California), which I refer with much doubt to this species of Piaget, taken from a *Polyborus brasiliensis* (Zool. Garden of Rotterdam). Piaget says that *maculatum* much resembles *C. flavescens*, the common *Colpocephalum* of raptorial birds (see Kellogg, New Mallophaga, II, 1896, p. 525 pl. lxxi, fig. 4). My specimens do not resemble *flavescens* at all closely, lacking the cross bands of the abdomen, being rather differently shaped, etc. But Piaget's description and figure of *maculatum* show it also to differ from *flavescens* in these and other particulars. My specimens measure: Male, body, length 1.62 mm., width .66 mm.; head, length .34 mm., width .53 mm. Female, body, length 2. mm., width .72 mm.; head, length .34 mm., width .53 mm.

Colpocephalum subæquale Nitzsch. (See Kellogg, New Mallophaga, II, 1896, p. 525, pl. lxxii, fig. 1).

Specimens from an American Raven, *Corvus corax sinuatus* (Baja California). Taken previously by me from *Corvus americanus* (Palo Alto, California).

Colpocephalum diffusum n. sp. (Plate IV, figs. 3 and 4).

A well marked species found upon a surprisingly large number of widely related bird species from Panama. Mr. McGregor brought specimens from the following birds: *Amblycercus holosericeus*, *Arremonops striaticeps*, *Saltator albicollis*, *Phænicothraupis fuscicauda*, *Elainea subpagana*, *Dendroica bryanti*, *Piaya cayana thermophila* (2 specimens), *Chiroxiphia lanceolata*, and *Ardea virescens*! From the condition of affairs I should suspect straggling, but Mr. McGregor informs me that

the birds were shot and the parasites collected on different days. We seem to have here a condition similar to the condition shown by *Docophorus communis*. In the list of hosts of this *Colpocephalum*, however, there are bird species of several unrelated families such as the Fringillidæ, Cuculidæ, Ardeidæ.

The specimens of the parasite vary somewhat in strength of color and hence distinctness of bands and blotches. Some of the weaker colored specimens, however, are evidently pupæ or freshly moulted adults. I have described the markings as shown in some well colored specimens from *Amblycercus holosericeus*.

Description of the male. Body, length 1.28 mm., width .53 mm.; ground color very pale, with distinct, blackish brown markings on head, thorax, and abdomen; transverse bands of abdomen uneven in size, the first and last bands being much larger than the middle ones.

Head, length .34 mm., width .47 mm.; a few short hairs on frontal margins; palpi barely projecting; ocular fringe distinct; temples broad, with a few long hairs; color whitish with prominent blackish ocular blotches projecting forward and connecting by a weakly colored, uneven broad line with the small but distinct blackish clypeal blotches; temples clear without dark margin; occipital margin narrowly bordered with blackish in the median part.

Prothorax; the part of the prothorax not concealed by the head is almost of the shape of a semicircle, a little flattened at the pole; the lateral angles lie very close to the occipital margin of the head, are obtuse, and bear three spines; there are three longish hairs on each lateral half of the rounded posterior margin; the segment is almost whitish with indications of darker

borders and indistinct lines caused by the sternal markings showing through. Metathorax pentagonal, posterior margin straight, with four longish hairs and a spine (between the first two) on each lateral half; the posterior angles with two spines; color whitish with dark brown anterior angles, and sternal markings indistinctly showing through. Legs concolorous with thorax, with brownish and blackish markings. Sternal markings distinct, blackish brown, consisting of a median wedge-shaped blotch on prosternum connected by lateral processes with the intercoxal lines; a peculiar four-appendaged blotch on mesosternum composed of median blotch and meso-peri-coxal lines; and a pale median metasternal blotch with darker intercoxal lines.

Abdomen short, broadly elliptical, not turbinate; two or three distinct spines in posterior angles of segments; longish hairs in the angles and on the dorsal surface; segment 1 large; segments 2 and 3 not so large but larger than segments 4-7; segment 8 larger than segment 2 or segment 3; broad blackish brown lateral bands with the sutures distinct; no transverse bands on dorsal surface, but those of ventral surface showing through; these transversal bands arranged as follows: a single broad band covering all of segment 1 and anterior half of segment 2, narrow bands on segments 3-7, and one continuous band or blotch covering all of segments 8 and 9; the genitalia strongly chitinized, conspicuous, and extending through segments 2-9; last segment rounded behind, with a few short hairs; on the ventral surface of segment 2, a group of four very strong, long spines near each posterior angle.

Female. Body, length 1.56 mm., width .66 mm.; head, length .34 mm.; width .5 mm.; abdomen more elongate and the segments differently shaped; segment

1 very long, with straight posterior margin; segment 2 a little shorter, with distinctly curving posterior margin; segment 3 still shorter, with curving margin; segments 4-7 very short; segment 8 longer; ventral bands about as in male, with the last great band or blotch reaching anteriorly, with convex anterior margin, into segment 5.

Menopon.

Menopon titan var. *linearis* Kellogg.

New Mallophaga, I, 1896, p. 163, pl. xv, fig. 2.

Many specimens from a Californian Brown Pelican, *Pelecanus californicus* (Baja California). Described from same host species from Bay of Monterey, California.

Menopon auri-fasciatum n. sp. (Plate IV, fig. 5).

From a Man o' War Bird, *Fregata aquila* (Panama). Not at all like *M. intermedium* Piaget (Les Pedieulines, p. 497, pl. xl, fig. 4) from *Fregata minor*.

Description of female. Body, length 2.19 mm., width 1.03 mm.; whitish with golden yellow transverse abdominal bands; dorsal surface of abdomen with many strong hairs in transverse series.

Head, length .31 mm., width .7 mm.; half-moon shaped, with smooth, even convex border; two short hairs on the front on each side of the middle, and two longish hairs and three shorter ones on each side in front of the antennal cavity; four very long hairs and several short ones in each temple; occipital margin concave, with six rather long hairs; pale yellowish white with black ocular flecks and small brown blotches just inside of the antennary cavities.

Prothorax rather large, with three short spines and a

long hair along the narrowly rounded margin of the lateral angles, and five long hairs on each lateral half of the flatly rounding posterior margin; the lateral margins narrowly darker than the rest of segment, which presents no blotches; the uncolored transverse chitin bar is distinct, and the curving longitudinal bars at its extremities are darker than general color of segment. Metathorax as short as or shorter than prothorax, with very slight lateral emargination; lateral posterior angle with several small spines, and posterior margin, which is flatly convex, bears, beginning in lateral angles, two long hairs, then a spine, then eight long hairs, on each lateral half; a narrow transverse pale brown blotch runs across the segment near the posterior margin and expands at its lateral extremities. Legs of pale ground color of thorax with narrow darker marginal markings.

Abdomen ovate, rather turbinate, with longish hairs in the posterior angles of the segments and a single series of strong hairs across the dorsal aspect of each segment, ranged along the posterior margin of a pale brown transverse band which extends entirely across each segment; this band covers only about one-half the dorsal aspect of each segment, the uncovered half being of the whitish ground color of the general body, ninth segment flatly convex behind, with fringe of uncolored fine hairs, and with a few long hairs at lateral rounded angles.

Menopon striatum n. sp. (Plate IV, fig. 6).

Six specimens from a Willow Ptarmigan, *Lagopus lagopus* (Kodiak Island, North Pacific Ocean). Nearly twice as large as Grube's *M. lagopi* from *Lagopus alpinus*, though in general appearance the species must be

similar. Grube describes the temples of *lagopi* with but one long hair; *striatum* has four, and the prothorax of *lagopi* is figured by Grube as being extraordinarily long.

Description of female. Body, length 2.22 mm., width .91 mm.; well marked, with entire transversal abdominal bands, with wide, whitish intersegmental spaces, and distinct, blackish, narrow lateral bands.

Head, length .3 mm., width .66 mm.; broadly parabolic in front, with slight rectangular orbital emargination; half a dozen short hairs on each lateral margin of forehead and three long hairs in region just in front of orbital emargination; the palpi projecting, as also the antennæ; temples narrow, five longish hairs, two more rising from occipital margin of temporal region; occipital margin concave, straight in the middle; ground color light brown, palest in median region, with very narrow blackish occipital border, blackish curving ocular blotches, and transversal dark brown bar in mandibular region.

Prothorax rather large, long; lateral angles obtuse, with three spines; posterior margin, from angle to angle, making a flattened semicircle and bearing 14 long hairs; ground color pale smoky brown, regions of lateral angles distinctly darker, transverse chitin bar dark, narrow, with a spine rising from each extremity; curving chitin bars at extremities of the transverse bar distinct, narrow. Metathorax with a broad whitish sutural space separating the small colored mesothoracic region from metathorax; metathorax with nearly straight posterior margin, and a series of hairs along straight posterior margin of broad chestnut-brown; transverse bar with narrow blackish lateral borders. Legs pale to smoky brown, with narrow, blackish dorsal

marginings and conspicuous spiny hairs. Sternal markings consisting of pale brown linear transversal blotch on prosternum, distinct, narrow blackish diagonal intercoxal lines between pro- and mesolegs, with pale brown median triangular blotch emarginated on anterior margin, very pale, indistinct intercoxal lines between meso- and metalegs, with a pale brown triangular median blotch between them, and another smaller pale brown median blotch apparently between the metacoxæ, really on first abdominal segment.

Abdomen elongate-elliptical; two to three or four longish hairs in lateral angles of segments; on segments 1-8 a regular series of alternating whitish (sutural) and chestnut-brown transversal (segmental) bands, each colored band bearing a single series of longish hairs on small pustules along its posterior margin; a longer hair on larger pustule at each end of each of these series; narrow, segmentally interrupted blackish lateral bands, separated from the brown transverse bands by a narrow whitish space; segment 9 wholly chestnut-brown except pale to uncolored posterior border; posterior margin with thick-set fringe of uncolored longer and shorter hairs. Ventral surface of abdomen of segments 2-8 with a median pale brown transversal band, bearing numerous fine hairs rising from small pustules; segment 9 mostly colored.

Menopon præcursor n. sp. (Plate IV, fig. 8).

Many specimens from a Gila Woodpecker, *Melanerpes uropygialis* (Baja California). Denny is the only author who has hitherto described a *Menopon* from the woodpeckers (*M. pici*, from *Picus viridis*, Monograph. Anoplur. Brit. p. 219, pl. xx, fig. 5). From his brief de-

scription and strange illustration I cannot determine whether my specimens resemble his or not.

Description of the female. Body, length 1.56 mm., width .75 mm.; golden brown, with chestnut-brown transverse abdominal bands.

Head, length .28 mm., width .58 mm.; being thus twice as wide as long; very few short hairs along front; from a partly clear spot on the dorsal surface on each side of the forehead three hairs arise of which one is very long; the palpi project by the length of the terminal segment; no distinct ocular fringe; the temples narrow and bearing three very long hairs and two or three shorter ones; occipital margin weakly concave, with six longish hairs, two being median; ground color of head pale subtranslucent brown, with nearly uncolored temples; black ocular flecks, irregular brownish ocular blotches, and a very narrow blackish occipital border. On the ventral surface are two backward-projecting, segmented, pointed, chitinous processes arising apparently at about the origin of the labial palpi.

Prothorax large, the obtuse lateral angles projecting even with the insertion of the last of the three long occipital hairs; the lateral margins and posterior margin (separated by a very obtuse but obvious angulation) with a few longish, slightly pustulated hairs (two on each lateral margin and six on the posterior margin); a spine in each lateral angle; the regions of the lateral angles smoky, with narrow blackish border on lateral margin; the straight, transverse chitin bar uncolored, the curving, longitudinal chitin bars blackish; middle region of segment concolorous with middle region of head. Metathorax short, but little wider than prothorax; posterior margin straight, with a series of longish hairs; region of posterior angles and an indistinct

transverse blotch entirely across segment darker. Legs concolorous with the pale ground color of the body, with very narrow darker dorsal margining. Sternal markings consisting of a narrow transversal median blotch on prosternum, and intercoxal lines curving backward at inner ends on mesosternum.

Abdomen rather short and broad, ovate; posterior angles projecting but slightly and bearing two to three long hairs; on the lateral margins of each segment a spine; a transverse series of hairs across each segment near its posterior margin; ground color very pale yellowish brown, with a chestnut-brown transverse band entirely across each segment except the ninth; posterior margin of segment 9 flatly angulated and with a close fringe of hairs.

Male. Body, length 1.34 mm., width .6 mm.; head, length .25 mm., width .53 mm.; the few specimens of males in the lot taken from the single bird examined are paler in color than the females; the transverse band of the eighth abdominal segment is hardly noticeable; segment 9 flatly rounded behind, with a few prominent hairs.

Physostomum.

With regard to the characters used in distinguishing species in this genus I am in much doubt. I believe that the genus is not at all well understood and that the specific determinations including my own (see *New Mallophaga* II, 1896, p. 513, *et. seq.*) need a thorough revision. This revision cannot, however, be undertaken until much more material is in hand. I describe the two following species with this doubt in mind, simply giving here as best I can additional data, for the

reviser. In the case of the two species here described, the unrelated hosts accredited to each suggest that we have to do in this genus with a few species of wide range of host, or with many species of very similar appearance.

Physostomum pallens n. sp. (Plate IV, fig. 7).

Specimens from a Prothonotary Warbler, *Protonotaria citrea* and from a Flycatcher, *Elainea subpagana* (Panama).

Description of female. Body, length 3.6 mm., width .87 mm.; pale buffy brown, with blackish brown head markings and thoracic markings and lateral abdominal bands.

Head, length .67 mm., width .66 mm.; front slightly expanded, flatly rounded; with laterally projecting palattes; several short prickle-like hairs in the slight ocular emargination; temples projecting backward, acute, with three long hairs, one on margin just behind the eye, and two close together on dorsal surface near the margin farther back; color whitish to clear with usual brown longitudinally arranged lateral blotches.

Prothorax hexagonal, front and posterior margins concave; a long hair and two spines in each lateral angle, and a long hair and two or three spines on each lateral margin near the posterior angles; lateral margins unevenly bordered with blackish brown, interrupted by a nearly uncolored spot in each lateral angle. Metathorax longer than prothorax, with straight posterior margin, and a single hair and spine in each posterior angle; a slight, rounded swelling behind anterior angles bearing spines; blackish brown, narrow, even, submarginal, longitudinal bands. Legs uncolored.

Abdomen parallel-sided, with a single hair and spine or prickle in posterior angles of segments; whitish with distinct, even, blackish brown submarginal longitudinal bands; vulva flatly rounded, with fringe of fine hairs; posterior margin of last segment flatly rounded, with fine, uncolored hairs.

***Physostomum invadens* n. sp.**

Specimens from a woodpecker, *Melanerpes wagleri* and from *Chiroxiphia lanceolata* (Panama). The finding of this species on *Melanerpes* is the first recorded occurrence of *Physostomum* on a non-passerine bird.

Description of female. Body, length 3 mm., width .81 mm; pale translucent brownish with dark brown to blackish head and thoracic markings and lateral abdominal bands; in outline and structural characters very like *pallens*.

Head, length .66 mm., width .6 mm.; almost identical with that of *pallens*; ground color browner; the hairs of ocular emargination rather longer and fewer. Prothorax with lateral angles hardly apparent, but marked by the presence of a long hair and spine. Legs with a little brownish coloring. Abdomen with longer hairs and more in posterior angles of segments, and with two hairs on posterior margin of each segment just a little distance inward from posterior angle. Lateral bands of abdomen rather broad and marginal; in each of these broad brown longitudinal bands the true lateral bands, chitinized, may be seen.

LIST OF HOSTS, WITH PARASITES.

<i>Larus glaucescens</i>	<i>Melanerpes wagleri.</i>
<i>Docophorus lari</i>	<i>Physostomum invadens.</i>
<i>Larus sp.</i>	<i>Melanerpes uropygialis.</i>
<i>Docophorus lari.</i>	<i>Menopon præcursor.</i>
<i>Nirmus punctatus.</i>	<i>Melanerpes formicivorus angus-</i>
<i>Colpocephalum abbotti.</i>	<i>tifrons.</i>
<i>Diomedea nigripes.</i>	<i>Docophorus californiensis.</i>
<i>Lipeurus confidens.</i>	<i>Myiarchus cinerascens nuttingi.</i>
<i>densus.</i>	<i>Docophorus rufus.</i>
<i>Eurymetopus taurus.</i>	<i>Elainea subpagana.</i>
<i>Pelecanus californicus.</i>	<i>Physostomum pallens.</i>
<i>Lipeurus forficulatus.</i>	<i>Colpocephalum diffusum.</i>
<i>Menopon titan var. linearis.</i>	<i>Corvus corax sinuatus.</i>
<i>Fregata aquila.</i>	<i>Colpocephalum subæquale.</i>
<i>Lipeurus gracilicornis, var.</i>	<i>Amblycercus holosericeus.</i>
<i>major.</i>	<i>Nirmus virgatus.</i>
<i>Colpocephalum spineum.</i>	<i>Colpocephalum diffusum.</i>
<i>Menopon auri-fasciatum.</i>	<i>Arremonops striaticeps.</i>
<i>Merganser serrator.</i>	<i>Colpocephalum diffusum.</i>
<i>Docophorus icterodes.</i>	<i>Saltator albicollis.</i>
<i>Anas carolinensis.</i>	<i>Colpocephalum diffusum.</i>
<i>Trinoton luridum.</i>	<i>Chiroxiphia lanceolata.</i>
<i>Ardea virescens.</i>	<i>Physostomum invadens.</i>
<i>Colpocephalum diffusum.</i>	<i>Colpocephalum diffusum.</i>
<i>Tringa macularia.</i>	<i>Cardinalis cardinalis igneus.</i>
<i>Docophorus cordiceps.</i>	<i>Docophorus communis.</i>
<i>Nirmus furvus var. ravis.</i>	<i>Phœnicothraupis fuscicauda.</i>
<i>Tringa sp.</i>	<i>Docophorus panamensis.</i>
<i>Nirmus fissus var. major.</i>	<i>Colpocephalum diffusum.</i>
<i>Lagopus lagopus.</i>	<i>Progne subis hesperus.</i>
<i>Lipeurus protervus.</i>	<i>Docophorus domesticus.</i>
<i>Goniodes mammillatus.</i>	<i>Phainopepla nitens.</i>
<i>Menopon striatum.</i>	<i>Nirmus peninsularis.</i>
<i>Polyborus cheriway.</i>	<i>Protonotaria citrea.</i>
<i>Nirmus splendidus.</i>	<i>Physostomum pallens.</i>
<i>Colpocephalum maculatum.</i>	<i>Dendroica bryanti.</i>
<i>Falco sparverius peninsularis.</i>	<i>Nirmus interpositus.</i>
<i>Nirmus fuscus.</i>	<i>Colpocephalum diffusum.</i>
<i>Crotophaga sulcirostris.</i>	<i>Cinclus mexicanus.</i>
<i>Lipeurus macgregori.</i>	<i>Docophorus laticeps var. amer-</i>
<i>Coccyzus americanus occidentalis.</i>	<i>icanus.</i>
<i>Docophorus latifrons var. occi-</i>	<i>Parus atri-capillus occidentalis.</i>
<i>dentalis.</i>	<i>Docophorus rutteri.</i>
<i>Piaya cayana thermophila.</i>	<i>Auriparus flaviceps.</i>
<i>Nirmus atopus.</i>	<i>Nirmus audax.</i>
<i>Colpocephalum diffusum.</i>	

EXPLANATION OF PLATES.

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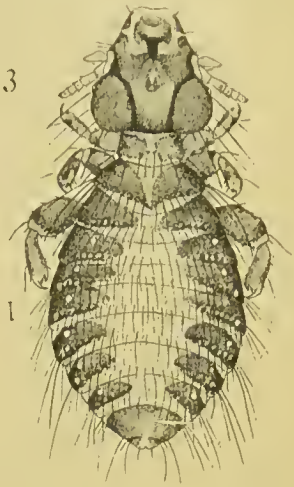
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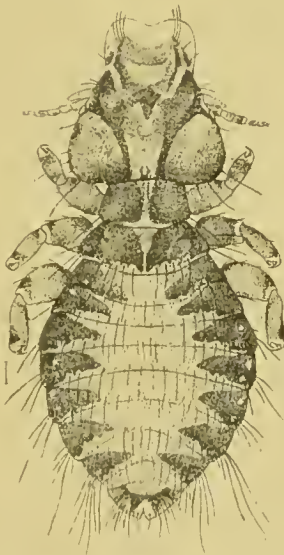
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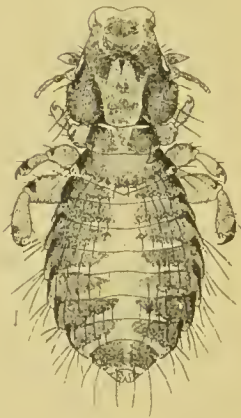
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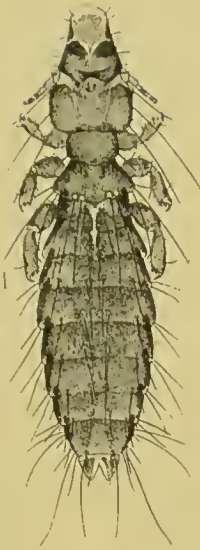


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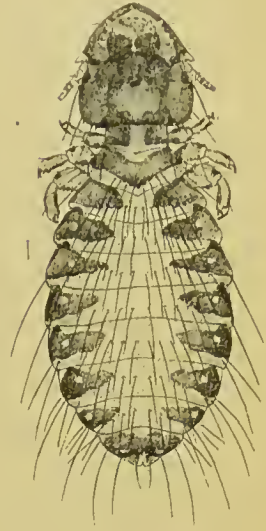




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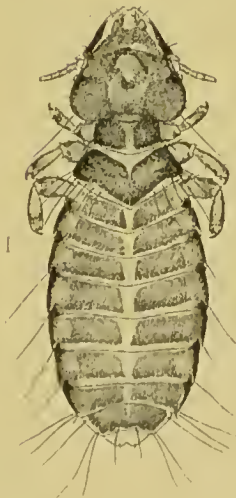
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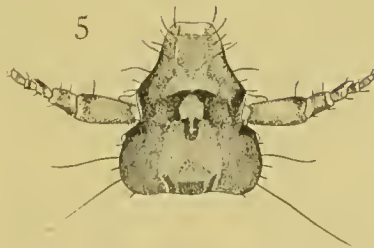
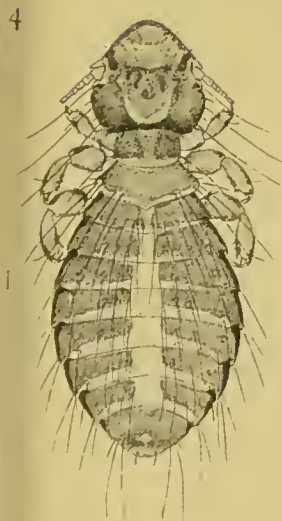


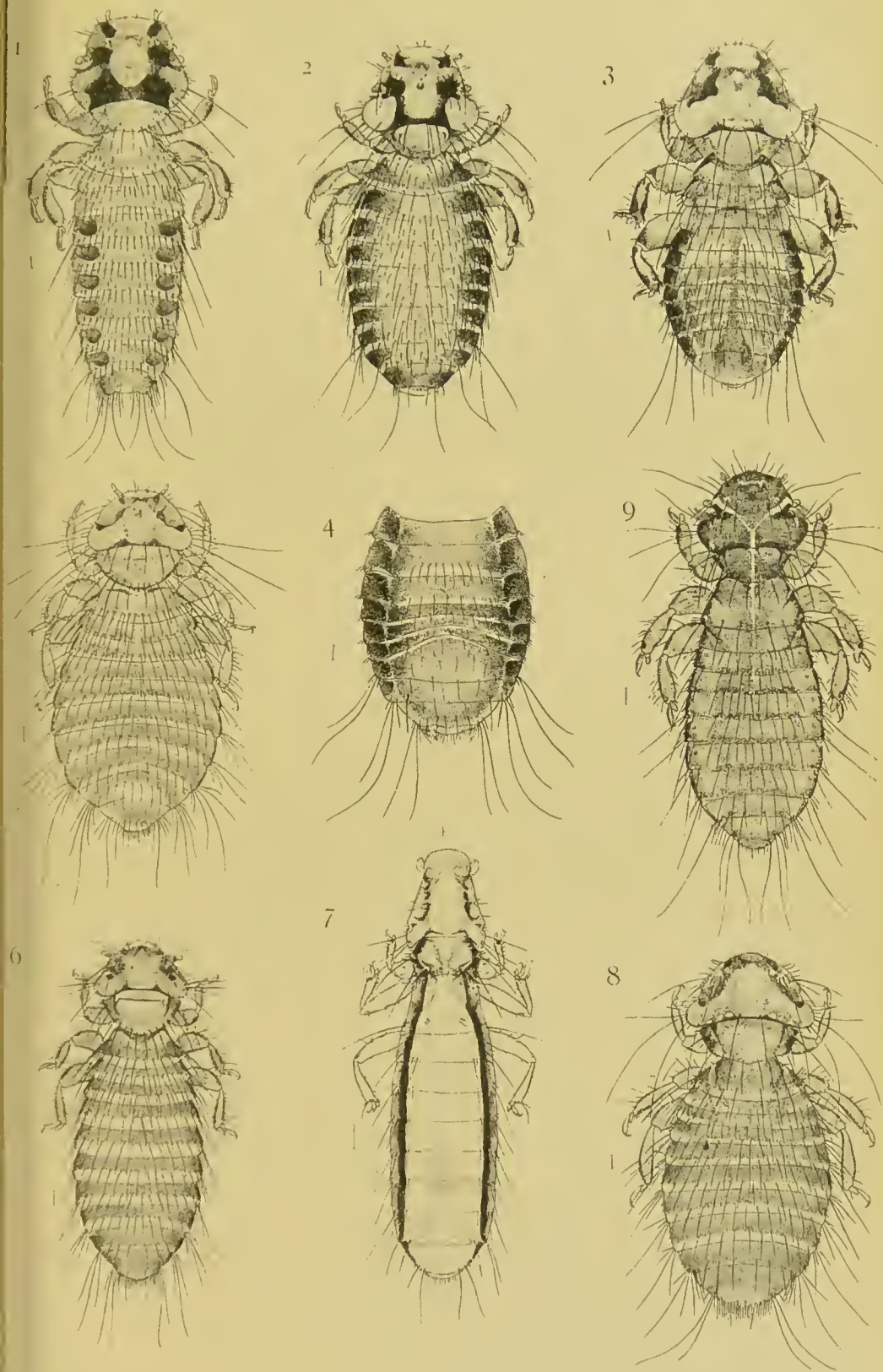
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MALLOPHAGA FROM BIRDS OF CALIFORNIA.

(With Plates V to IX.)

BY VERNON L. KELLOGG AND BERTHA L. CHAPMAN.

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INTRODUCTION.

The Mallophaga described and referred to in this paper were collected by Messrs. Snodgrass, Osgood, Brown, and McLain, students of Stanford University, California, Mr. Ed. M. Ehrhorn, Horticultural Commissioner for Santa Clara County, California, and by the senior author, Mr. Kellogg. All of the specimens from birds of the Bay of Monterey, California, were taken by Mr. Kellogg from just-killed birds or freshly made skins collected by Mr. Leverett M. Loomis, Curator of the Department of Ornithology, California Academy of Sciences. The authors desire to acknowledge their obligations to these various collectors.

The sequence of genera in this paper is that adopted in the European monographs and in the papers of the senior author (Kellogg, New Mallophaga I, 1896;* New Mallophaga II, 1896;* Mallophaga from Birds of

* Proc. Cal. Acad. Sci., 2d. Ser. Vol. VI.

Panama, Baja California, and Alaska, in New Mallophaga III, 1899). The sequence of species in each genus is determined by the hosts, the sequence of hosts being that of the A. O. U. Check-List of North American Birds, 2d. edition, 1895.

Docophorus.

Docophorus procax n. sp. (Plate V, fig. 1).

Many specimens from two Pigeon Guillemots, *Cephus columba* (Bay of Monterey, California). A member of the group *trianguliferi* Piaget (Les Pediculines, p. 113), and most resembling *pilosus* Piaget (ibid, p. 116, pl. x, fig. 4) from a flamingo, *Phœnicopterus antiquorum*, but differing in the hairs of clypeus, of metathorax, shape of abdominal blotches, etc.

Description of the male. Body, length 1.45 mm., width .76 mm.; head comparatively large, with frontal part of clypeus uncolored and expanded; thorax and first segment of abdomen golden brown with darker markings; abdomen oval, pale, whitish medially, with dark brown transverse bands and blackish lateral bands.

Head, length .52 mm., width .54 mm.; conical, temples wide, sides rapidly approaching each other anteriorly; frontal uncolored clypeal space expanded; front straight or feebly concave; no hairs on the rounding uncolored clypeal region but one short marginal prickle at the point where the clypeus begins to swell beyond the sides of the head; a second short prickle before the suture; two dorsal hairs just before the clear uncolored clypeal region; two short prickles in front of the trabeculæ; trabeculæ large, reaching nearly to the end of the second segment of the antennæ, well col-

ored with pale brown, a short prickle at the base; antennæ small, of the same golden brown as the head, with slightly darker markings; eye inconspicuous, with two short prickles and an ocular fleck; temples rounded, with two long hairs and several prickles; occipital margin straight; clypeal signature broadly shield-shaped, sides constricted anteriorly, with posterior angle reaching almost to the mandibles; the quadrangular space in the middle of the signature is slightly darker than the most anterior portion; antennal bands interrupted by the suture, the bands turning in at the suture, nearly meeting on the median line, the bands themselves becoming narrow and acuminate; the posterior ends of the antennal bands bend in and back till they meet the dark blotch caused by the mandibles showing through the head; ocular blotches distinct; temporal borders narrow, occipital bands distinct, slightly diverging anteriorly; occipital border not extending to the sides of the head.

Prothorax broad, with sides diverging; posterior angles rounding; lateral borders dark, extending in along the posterior margin. Metathorax pentagonal, sides strongly divergent, posterior margin angular, with slightly rounding tip on the abdomen; one short prickle and one long pustulated hair in the posterior angles, three pustulated hairs each side of the posterior marginal angle; segment pale in the middle, growing darker laterally and posteriorly. Legs of the same golden brown as the thorax, darker lateral borders and annulations, claws also dark. Sternal markings consist of dark brown intercoxal lines and a pale median metathoracic blotch.

Abdomen broadly ovate, turbinate; segments 2 to 7 with prominent posterior angles, each bearing

from one to three long hairs; segment 1 wholly golden brown, the transverse blotches meeting near the posterior margin in an acute point; the transverse lateral blotches of segments 2 to 7 are separated by a transparent whitish median space; the lateral margins of the segments are dark brown to black; along the posterior margins of the transverse lateral bands are partially uncolored spots bearing long hairs; stigmal spots distinct; segment 8 wholly pale brown, darker in the middle, owing to the dark genitalia showing through; segment 9 very small and uncolored; genitalia distinct, dark brown reaching as far forward as segment 6.

Female. Body, length 1.62 mm., width .78 mm.; head, length .56 mm., width .53 mm.; abdomen not so broad in comparison with the length as in the male, not turbinated, and the median whitish space larger.

Docophorus lari Denny. (See Kellogg, New Mallophaga, I, 1896, p. 98, pl. iv, fig. 4).

Specimens from *Larus delewarensis*, *L. occidentalis* (three birds), and *L. heermanni* (two birds) (Bay of Monterey, California). Previously taken by Kellogg from these and other species of *Larus*.

Docophorus melanocephalus Burmeister. (See Kellogg, New Mallophaga, I, 1896, p. 99, pl. iv, fig. 6).

Two specimens from the Royal Tern, *Sterna maxima* (Bay of Monterey, California), and two specimens from the Pomarine Jaeger, *Stercorarius pomarinus* (Bay of Monterey, California). Previously taken by Kellogg from *Sterna maxima* (same locality).

Docophorus validus n. sp. (Plate V, fig. 2).

A single female specimen of this striking *Docophorus* from a Black-vented Shearwater, *Puffinus opisthomelas*

(Bay of Monterey, California). In general shape and in certain special characters this new form somewhat resembles *D. brevi-antennatus* Piaget (Les Pediculines, p. 108, pl. ix, fig. 9) from *Sula australis* (Museum of Leyden); the differences, however, in shape of meta-thorax, abdominal blotches, etc., are marked.

Description of the female. Body, length 2.25 mm., width 1.18 mm.; large triangular head with narrow, emarginate front; abdomen nearly circular, with strongly marked, lateral, transverse blotches, mostly acute inwardly.

Head, length .72 mm., width .72 mm., front of the head before the trabeculæ elongate and markedly narrowing anteriorly; dark lateral margins extending slightly beyond the narrow, concave, uncolored clypeal region, terminating in a sharp, slightly incurving angle; a short prickle on the anterior margin of this projecting angle, a short hair on the lateral margin of the front, near the suture; two dorsal hairs extending beyond the lateral margin of the head; trabeculæ large, reaching to the end of the second segment of the antennæ; segment 1 of the antenna long, segment 5 but little longer than segments 3 or 4; eyes prominent, with a short spine and a hair; temples slightly protruding, parabolic, with two long hairs and three short spines; occipital margin slightly convex upon the prothorax; signature distinct, anteriorly concave; deeper chestnut-brown along the anterior margin than through the wide median portion, posteriorly narrowing into a dark, narrow, acuminate point reaching to the mandibles; the anterior portion of this posterior point is darker than the rest of the signature; antennal bands broad, even, of a dark, rich, golden brown, paling slightly in the anterior portion, beyond the suture; posterior extremities bending inwardly, separated by a

pale median space between the occipital bands; occipital bands much paler than the temporal borders, indistinctly fading anteriorly into dark ocular blotches; temporal margins narrowly bordered with dark brown; occipital blotches distinct.

Prothorax small, oblong; angles rounding, with one long hair; lateral blotches distinct, separated by a pale median line, darker along the posterior margin near the angle, and fading gradually anteriorly. Metathorax only two-thirds as wide as the head, with strongly diverging sides, rounding, posterior angles; posterior margin broadly rounded upon the abdomen; one very short prickle and one long hair in a pale brown space on the posterior angle; six long pustulated hairs on the posterior margin; lateral markings little darker than the general dark brown of the metathorax.

Abdomen nearly circular; transverse, lateral blotches distinct, acute inwardly, and darkest at the inner ends; each bearing from one to four pustulated hairs; segment 8 entirely dark brown; segment 9 rounding, with a narrow, angular emargination; one fine hair each side of this emargination.

Docophorus icterodes Nitzsch. (See Kellogg, New Mallophaga, I, 1896, p. 96, pl. iv, fig. 1).

Specimens from a Lesser Scaup Duck, *Aythya affinis*, and from an American Scaup Duck, *Aythya marila nearctica* (Palo Alto, California). Previously taken by Kellogg from the first named host species, and from six other duck species.

Docophorus fusiformis Denny. (Plate V, fig. 3).

Monographia Anoplurorum Britanniae, 1842, p. 84, pl. i, fig. 2.

Docophorus fusiformis D., Giebel, Insecta Epizoa, 1874, p. 104; Pictet, Les Pediculines, 1880, p. 86, pl. vi, fig. 7.

Docophorus fissiformis D., Osborn, Insects Affecting Domestic Animals, Bull. 5, N. S., Div. of Ent., U. S. Dept. Ag., 1896, p. 217.

One male from a Least Sandpiper, *Tringa minutilla* (Palo Alto, California). Denny's specimens were taken from the same host; Giebel's single specimen from the same host, and Piaget's from *Tringa subarquata*. Osborn's specimens are from the "black-billed sandpiper" (Burnett collection). Our specimen has no emargination of the clypeal front, a character especially noted by Denny and Piaget. But Giebel's specimen is like ours: "der Vorderrand ist nicht tief ausgeschnitten, sondern nur sanft concav." The species can be recognized by the large elongate head, the dark coloration, and narrow genitalia. Our specimen, figured, measures: body, length, 1.31 mm., width .5 mm.; head, length .5 mm., width .44 mm.

***Docophorus fuliginosus* Kellogg.**

New Mallophaga, I, 1896, p. 80, pl. iii, fig. 2.

Specimens from the Black-bellied Plover, *Squatarola squatarola*, and from the Semipalmated Plover, *Aegialitis semipalmata* (Pacific Grove, California). Described from *Squatarola squatarola* (Kansas and California).

***Docophorus pictus* Giebel. (Plate V, fig. 4).**

Insecta Epizoa, 1874, p. 74.

Docophorus pictus G., Piaget, Les Pediculines, 1880, p. 23.

Numerous specimens from a Golden Eagle, *Aquila chrysaëtos* (Palo Alto, California). The specimens are of the characteristic group infesting eagles, of which *platystomus* N. (Giebel, Insecta Epizoa, p. 69, pl. ix, fig. 1; Piaget, Les Pediculines, p. 17, pl. i, fig. 1) may be taken as type. So many species have been described in this group, on what seems to us slight differences, that one may well despair of making a satisfactory reference of his specimens to any one of the forms to the exclusion

of all others. From this same host half a dozen species of *Docophorus* (all of the *platystomus* type) have been described.

The truncate, not emarginated, clypeal front, and the slight dilation of the uncolored part of the clypeus lead us to refer our specimens to a species proposed by Giebel for specimens collected from the same host as that of our specimens. Osborn (Insects Affecting Domestic Animals, 1896, p. 218,) describes a species *halioti* from the Bald Eagle, *Halicaetus leucocephalus* (Florida). This species has a marked lateral, anterior, clypeal dilation, and the front is emarginate.

The members of the group may be recognized by the uncolored front of the clypeus more or less dilated. We figure a female. Measurements: Male, body, length 2.22 mm., width 1.2 mm.; head, length .85 mm., width .91 mm. Female, body, length 2.81 mm., width 1.4 mm.; head, length .94 mm., width 1. mm.

Docophorus cursor Nitzsch. (See Kellogg, New Mallophaga, II, 1896, p. 484, pl. lxvi, fig. 1).

Specimens from two individuals of the American Long-eared Owl, *Asio wilsonianus*, (Ontario, California). Taken previously by Kellogg from *Bubo virginianus* (Lawrence, Kansas). Recorded by Osborn from *Asio wilsonianus* (Ames, Iowa, and Lincoln, Nebraska).

Docophorus speotyti Osborn.

Insects Affecting Domestic Animals, 1896, Bull. No. 5, Div. o
Ent., U. S. Dept. Ag., p. 222, fig. 144.

Specimens from a Spotted Owl, *Syrnium nebulosum* (La Honda, California). Agrees well with Osborn's description (except that the abdomen is narrow, with subparallel sides in the *female*, while it is more ellipti-

cal, widest at segment 4, in the *male*, just the reverse of the condition according to Osborn).

Docophorus ceblebrachys Nitzsch. (See Kellogg, New Mallophaga, II, 1896, p. 485, pl. lxvi, fig 3).

Many specimens from a Snowy Owl, *Nyctea nyctea* (Pullman, Washington). Taken previously by Kellogg from same host (Kansas).

Docophorus singularis n. sp. (Plate V, fig. 5).

Specimens from a Nuttall's Woodpecker, *Dryobates nuttallii* (Ione, California). Not like any other woodpecker-infesting *Docophori*, but belongs rather to the group *femorati*.

Description of the female. Body, length 1.43 mm., width .71 mm.; dark chestnut-brown with distinct bands on the head and thorax, angular, lateral, transverse blotches on the abdomen; unique in the possession of bipartite trabeculæ.

Head, length .65 mm., width .53 mm.; large, broadly concave, uncolored clypeal region broad with straight to slightly concave front; one marginal hair in front of distinct suture, two dorsal hairs near the lateral margin, one rather short and stiff, extending forward beyond the clypeal margin, the second very long; two dorsal hairs in front of the trabeculæ; the trabeculæ divided, anterior part short and acutely angulated, extending around the base of the posterior portion of the trabeculæ on the ventral surface, the posterior portion of the trabeculæ nearly as long as the first two segments of the antennæ, about the same width throughout, a deep chestnut-brown at the base, with uncolored tip; antennæ with the first two joints long and about equal, pale golden brown, last three joints darker chestnut-brown,

a few short spines on the joints, especially numerous and strong on the first two joints; eye with one long hair, and near the posterior margin a second long hair; temples rounding, with three long, pustulated, marginal hairs and one short prickle, occipital margin slightly convex; signature distinct, anterior margin concave, with a slight lateral constriction near the anterior angles, posterior angles extended backward, posterior margin extending in a long, acute angle beyond the mandibles; antennal bands distinctly interrupted at the suture, dark chestnut-brown, posterior extremities inward and back, meeting well defined, diverging occipital bands; temples dark chestnut-brown, with narrow blackish margins, interrupted by large pustulations.

Prothorax small, lateral margins strongly rounding; one long pustulated hair in the posterior angle; lateral blotches dark chestnut-brown, separated by a pale median line; blackish lateral borders. Metathorax with strongly divergent lateral margins nearly as wide as the head; a series of long pustulated hairs on the angulated posterior margin; lateral blotches dark, separated by a pale median line which widens distinctly near the middle; bands of blackish brown on the lateral and posterior margins. Sternal markings composed only of the distinct intercoxal lines between the pro- and mesothoracic legs. Legs pale brown with dark bands.

Abdomen broadly ovate, segments distinctly narrowing on the median line; one to three long hairs in the posterior angles; many long, pustulated, dorsal hairs in a transverse series on the posterior margin of each segment; lateral transverse triangular blotches dark chestnut-brown, slightly darker on the lateral margin; median portion of the abdomen uncolored; posterior margin of the transverse blotches interrupted by uncolored pustulations; segment 8 entirely dark brown;

segment 9 narrowly emarginate, rounding, with two short prickles on the posterior margin; two dark lateral blotches separated by a broad uncolored space; genital blotches distinctly dark brown, broadly rounding on segments 5 and 6, posterior margin rapidly tapering to segment 8.

Male same size as female; last segment broadly, flatly rounded, with several long hairs on each side of the bare median third of the posterior margin.

***Docophorus californiensis* Kellogg.**

New Mallophaga, II, 1896, p. 483, pl. lxvi, fig. 6.

Specimens from Williamson's Woodpecker, *Sphyrapicus thyroideus* (El Dorado county, California), the White-headed Woodpecker, *Xenopicus albolarvatus* (El Dorado county, and Kings River Cañon, California), and the Californian Woodpecker, *Melanerpes formicivorus bairdi* (Palo Alto, California). Types collected by Kellogg from *Melanerpes formicivorus bairdi* (Palo Alto, California). The specimens from the El Dorado county birds show narrow heads and bodies, but this is probably due to shrinking in drying, as all the specimens of the small collections from this locality appear to have suffered in the same way.

***Docophorus rufus* Kellogg.**

Mallophaga from Birds of Panama, Baja California and Alaska, in New Mallophaga, III, 1899, p. 7, pl. i, figs. 6 and 9.

Three specimens from an Ash-throated Flycatcher, *Myiarchus cinerascens* (Alameda county, California) and three specimens from another specimen of the same bird species from Ontario, California. Described by Kellogg from *Myiarchus cinerascens nuttingi* (Baja California).

Docophorus fusco-ventralis Osborn.

Insects Affecting Domestic Animals, 1896, Bull. 5, N. S., Div of Ent., U. S. Dept. of Ag., p. 221.

One specimen from an Ash-throated Flycatcher, *Myiarchus cinerascens* (Palo Alto, California). Osborn's specimens were from the Wood Pewee, *Contopus virens* (Cornell University Collection; Burnett Collection).

Agrees well with Osborn's description, except that the fuscous coloration of ventral aspect is in broad transverse bands separated by distinct, paler sutural bands, instead of being "beneath uniformly dark brown."

Docophorus communis. (See Kellogg, New Mallophaga, II, 1896, p. 486, pl. lxvi, fig. 7).

Under this name we group together a large number of very similar forms; or if dissimilar, forms connected by gradatory specimens. These forms are taken from passerine birds and belong to Piaget's group *femorati* (Les Pediculines, p. 53), characterized by the large truncate or feebly convex or weakly emarginated clypeus, with long hair in each anterior angle, by the especially large third pair of legs, and by the conspicuous pustulated hairs of the thorax and abdomen. The marked variation (notably in size of hindmost legs) among individuals from a single bird specimen (let alone bird species) and the series of gradatory forms connecting all the variations manifest in the group make it impossible for us to attempt to distinguish different species in this mass of material. Piaget has, indeed, attempted to define half a dozen varieties of *communis*, but in no very confident manner. The group *femorati* can furnish time-killing work for any student bold enough to undertake its discipline.

Docophori of this group, referable to the species *communis*, in its widest sense, have been determined by us

from the following passerine hosts, all from California: Ash-throated Flycatcher, *Myiarchus cinerascens*; Western Flycatcher, *Empidonax difficilis*, two specimens; Mexican Horned Lark, *Otocoris alpestris chrysolæma*; Blue-fronted Jay, *Cyanocitta stelleri frontalis*, three specimens; California Jay, *Aphelocoma californica*; Western Meadow Lark, *Sturnella magna neglecta*; Brewer's Blackbird, *Scolecophagus cyanocephalus*; Pine Siskin, *Spinus pinus*; Western Lark Sparrow, *Chondestes grammacus strigatus*, two specimens; Intermediate Sparrow, *Zonotrichia leucophrys intermedia*; Gambel's Sparrow, *Zonotrichia leucophrys gambelii*, three specimens; Golden-crowned Sparrow, *Zonotrichia coronata*, two specimens; *Spizella* sp.; Western Chipping Sparrow, *Spizella socialis arizonæ*; Bell's Sparrow, *Amphispiza belli*; Samuel's Song Sparrow, *Melospiza fasciata samuelis*, two specimens; California Towhee, *Pipilo fuscus crissalis*, two specimens; Black-headed Grosbeak, *Zamelodia melanocephala*; Western Blue Grosbeak, *Guiraca caerulea eurhyncha*, three specimens; Louisiana Tanager, *Piranga ludoviciana*, two specimens; Cedar Waxwing, *Ampelis cedrorum*; Northern Shrike, *Lanius borealis*; California Shrike, *Lanius ludovicianus gambeli*, two specimens; Cassin's Vireo, *Vireo solitarius cassinii*; Yellow Warbler, *Dendroica aestiva*; Vigor's Wren, *Thryothorus bewickii spilurus*; Plain Titmouse, *Parus inornatus*, three specimens; Audubon's Hermit Thrush, *Turdus aonalaschkae auduboni*; Western Bluebird, *Sialia mexicana occidentalis*. Previously taken by Kellogg from sixteen species of passerine birds.

Docophorus mirinotatus n. sp. (Plate V, fig. 6).

A female and several immature specimens from a Thurber's Junco, *Junco hyemalis thurberi* (Goat Mt.,

alt. 11,500 ft., Kings River Cañon, California). This Nirmoid form does not much resemble any other *Docophorus* known to us. The strangely emarginated, transverse abdominal blotches are unique.

Description of the female. Body, length 1.65 mm., width .53 mm., slender, Nirmoid in form, with head wider than thorax and almost as wide as abdomen; abdomen yellowish white, with narrow blackish lateral bands, and transverse bands with their anterior margins widely and irregularly emarginated.

Head, length .46 mm., width .43 mm.; clypeus broad, with straight or very slightly concave front; one short hair in the lateral margin near the front, a second longer hair in front of the suture; eye with a long hair; temples flatly rounding, with two very long hairs and two or three prickles; markings indistinct; antennal bands interrupted at the suture; occipital bands widely separated posteriorly but converging rapidly anteriorly, forming a triangle with the mandibles at apex; trabeculae slender, short.

Prothorax narrow, quadrangular, with a long hair in the posterior angle; pale medially, with distinct dark lateral bands. Metathorax with a series of long hairs along the posterior margin which is distinctly angulated on the abdomen; lateral, dark brown borders.

Abdomen slender, elongate-elliptical; from one to three long hairs in the posterior angles of the segments and a dorsal, transverse series of long pustulated hairs on each segment rising near the middle of the segments; segments with median blotches which are widely and irregularly emarginate anteriorly, the blotches also interrupted by the pustulations which fade into the medial emargination; the transverse blotches distinctly darker on the posterior margin just

beneath the uncolored medial space and extending laterally not quite to the lateral bands; distinct narrow blackish bands on the lateral margins; last segment narrowly, angularly emarginate, with a short hair on the posterior margin each side of the emargination, and with pale brown transverse blotches, but no dark bands on lateral margins.

Docophorus mirus n. sp. (Plate V, fig. 7).

A few specimens from two Vigor's Wrens, *Thryothorus bewickii spilurus* (Palo Alto, California). Characterized by the very large head and small abdomen, the head being two-fifths as long as the whole body and almost, if not quite, as wide.

Description of the female. Body, length 1.5 mm., width .65 mm.; head very large in proportion to the body, five-sixths as wide as the abdomen and two-thirds as long.

Head, length .56 mm., width .53 mm., broadly conical; uncolored clypeal front slightly concave in the middle, a rather long stiff dorsal hair rising near the lateral margin and extending forward beyond the margin of the head, a short hair on the margin in front of a distinct suture, two rather long hairs before the trabeculae which reach as far as the end of the second segment of the antennae; segment 2 of the antennae long, segment 5 longer than either segment 3 or 4; eye distinct, a long hair on the dorsal surface and a shorter hair arising near the posterior angle; three long hairs and a short prickle on the rounding angle of the temples; occipital margin slightly convex; signature distinct, pale fulvous, anterior margin slightly concave; lateral margins straight, though the dark, narrow lines of the inner bands make it appear that there is a strong

constriction near the anterior margin; posterior angles rounding; posterior margin extending back beyond the mandibles in a dark, narrow point; antennal bands marginal, narrow, dark chestnut-brown, interrupted by the distinct suture, bending in to meet the anterior ends of the occipital bands in an indefinite, pale fulvous band; temples bordered anteriorly with a narrow border of dark chestnut; occipital bands narrow but distinct posteriorly, widely diverging and apparently connecting with the antennal bands.

Prothorax narrow, about half as wide as the head; lateral margin convex, one long pustulated hair in the posterior angles; a narrow lateral border of dark chestnut-brown. Metathorax with sides convex and strongly diverging; a series of long pustulated hairs on the posterior margin which is obtusely angled on the abdomen; lateral margin bordered with dark chestnut-brown. Legs fuscous, with dark fuscous borders and semiannulations; third pair of legs conspicuously large; a few scattered hairs and spines.

Abdomen broadly ovoid, short in comparison with the large head; first three segments longer than the others, their posterior margins more nearly straight; segments 4 to 8 narrowed, especially in the middle; last segment narrowly emarginate; many long pustulated hairs on the abdomen arranged in series on the posterior margin of each segment, especially thick along the middle; three or four short prickles on the lateral margin of the emargination of the last segment; first four segments dark chestnut-brown, segments 5 to 9 paler fuscous.

Male. Body, length 1.46 mm., width .53 mm.; head, length .53 mm., width .5 mm.; last abdominal segment rounded, with a fringe of about ten rather long weak hairs.

Nirmus.

Nirmus fusco-marginatus Denny. (Plate V, fig. 9).

Monograph. Anoplur. Brit., 1842, p. 136, pl. x, fig. 1.

Nirmus fusco-marginatus D., Giebel, Insecta Epizoa, 1874, p. 178;

Piaget, Les Pediculines, 1880, p. 202, pl. xvi, fig. 6.

Many specimens of a *Nirmus* which may be referred to as a variety of this species of Denny, from an American Eared Grebe, *Colymbus nigricollis californicus*; also two specimens (rather smaller) from two Pigeon Guillemots, *Cephus columba*, and a single specimen from the American Herring Gull, *Larus argentatus smithsonianus* (all the birds from the Bay of Monterey, California). Denny's types were taken from *Podiceps auritus* (Ireland), and Piaget's specimens from *Podiceps cristatus*. It seems to me that the *Nirmus podicipis* of Denny (Monograph. Anoplur. Brit. p. 142, pl. x, fig. 9) and the *Lipeurus runcinatus* Nitzsch (Giebel, Insecta Epizoa, p. 238) are both referable to *fusco-marginatus*. The antennal characters seem to be the same. As Piaget notes, the differing in the antennæ of male and female makes it difficult to refer the species to *Nirmus*. It is a form showing a transition to *Lipeurus*. Our specimens are one-fourth larger than the types of the species and differ in some minor particulars.

Var. *americanus* Kellogg and Chapman. (Plate V, fig. 9). Female, body, length 2.62 mm., width .81 mm.; head, length .56 mm., width .44 mm. Differs from the species type in having a spine in the posterior angles of the prothorax, and a hair on each lateral half of the posterior margin; the metathorax has six hairs and a spine on each lateral half of the posterior margin. The species is easily recognizable by its long slender body, short, narrow, pointed head, and the black, lateral, triangular, abdominal blotches with brown inward-projecting processes.

Nirmus pacificus n. sp. (Plate V, fig. 8).

Two males from a Tufted Puffin, *Lunda cirrhata*; one male from a Black-bodied Shearwater, *Puffinus griseus*; and specimens, males and females, from two Pigeon Guillemots, *Cephus columba*—all the birds from the Bay of Monterey, California. The specimen from *Puffinus* is almost certainly a straggler, as no other specimen was taken from the fifty-five individuals of *Puffinus* examined. The new species belongs to Piaget's group *zonati* (Les Pediculines, p. 187), and is most like *citrinus* (ibid. p. 190, pl. xvi, fig. 8). The metathorax, however, is angulated, not flatly rounded, as with *citrinus*, on the abdomen, and there are other differences.

Description of the male. Body, length 1.46 mm., width .5 mm.; short, broad, Docophoroid in form; light golden brown with conspicuous broad, dark antennal bands and dark brown to black lateral abdominal bands interrupted segmentally.

Head, length .5 mm., width .4 mm.; broadly conical; clypeal front very slightly concave; three marginal hairs on the front, one on the clear portion, and two before the suture; a short marginal prickle in front of the trabeculæ, one dorsal hair just back of the first marginal, a second dorsal hair near the second marginal, two dorsal hairs between the suture and the trabeculæ which are distinct and slightly colored; the antennæ are short, segments 2 and 5 being longer than the others; color, the light golden brown of the head marked with slightly darker brown; eyes inconspicuous, with two short prickles; temples with sides nearly straight, rounding on posterior angles, with one very long hair, one shorter, weaker hair, and two short prickles; occipital margin concave; clypeus with a pale

but distinct pentagonal signature; antennal bands broad and dark, continuing beyond the suture; behind the obtuse posterior angle of the signature a narrow longitudinal uncolored space extending to the mandibles; temples bordered by a very narrow line of dark brown slightly broader just below the eye; a distinct though pale occipital signature.

Prothorax quadrangular, very short, broadly rounded, angles with one rather long hair; pale medially with dark brown lateral margins that bend in along the posterior margin. Metathorax pentagonal with widely diverging sides; posterior angles acute; six hairs in the angle and along the posterior margin; the posterior margin with a distinct elongate angle on the abdomen; dark lateral markings broadest on the posterior angles. Legs pale golden brown with slightly darker marginal markings.

Abdomen slightly elongate-oval, turbinate; posterior margins of segments 1-3 angulated, and anterior margins of segments 6-9 more obtusely angled; lateral angles of segments with one to three hairs; a few hairs on dorsal surface arranged along the posterior margins of the segments; posterior margin of segment 9 broadly rounded, with ten rather long hairs, several shorter hairs on dorsal surface of segment; color of abdomen fuscous; segment 1 without distinct lateral blotches, but segments 2-7 with dark brown to black lateral blotches, darkest in anterior angles and extending along the anterior margin of each segment almost to the median line; segment 8 but little darker in anterior angle, and segment 9 of an even pale fuscous; genitalia distinctly showing through, extending to segment 6.

Female, body, length 1.75 mm., width .6 mm.; head, length .55 mm., width .47 mm.; lateral abdominal

bands distinct, blackish, the posterior part of each segmental portion tapering acuminate; segment 8 without lateral bands; segment 9 widely, angularly emarginate behind, with a single very fine short hair on each obtuse posterior point.

Nirmus maritimus n. sp. (Plate VI, fig. 1.)

Many specimens from numerous individuals of the Ancient Murrelet, *Synthliboramphus antiquus*, Cassin's Auklet, *Ptychoramphus aleuticus*, Rhinoceros Auklet, *Cerorhinca monocerata*. Also a single specimen (straggler) from a Pacific Fulmar, *Fulmarus glacialis glupischa*. All of these birds from the Bay of Monterey, California. Resembling *N. citrinus* Nitzsch (Giebel, Insecta Epizoa, p. 177; Piaget, Les Pediculines, p. 190, pl. xvi, fig. 8) from *Alca torda*, but more slender, with elongate head, angulated posterior margin of metathorax, different disposition of hairs of the head, etc.

Description of the female. Body, length 1.96 mm., width .46 mm.; slender, elongate; pale fuscous with darker lateral borders on the head and thorax and broad lateral bands on the abdomen.

Head, length .5 mm., width .37 mm.; narrowly elongate, conical, with clypeal front convex; three marginal hairs, the first one near the front and the third in front of the suture, the second is midway between these; a short prickle in front of the trabeculae which reach to the end of the first segment of the antennae; antennae short, not reaching more than two-thirds of the distance to the occipital margin; segment 2 longer than segment 1, and segment 5 longer than segments 3 or 4; a few short hairs on the segment; eye with a hair and a short prickle; temples with sides nearly parallel; one long hair, one short hair, and three short

prickles on the margin; occipital margin slightly concave; signature distinct, shield-shaped, anterior margin convex, posterior margin produced in a narrow point; antennal bands broad, interrupted by a distinct uncolored suture; the anterior extremities of the antennal bands bend broadly in at the suture, being separated medially by a narrow uncolored line that reaches nearly if not quite to the mandibles; ocular blotch fading inwardly; temporal borders narrow but well defined, broader just below the eye, gradually narrowing till it disappears before the occipital angle; a distinct conical occipital signature showing through from the under side of the head.

Prothorax with sides slightly diverging; posterior angles rounding, with one short hair; marginal borders dark golden brown, darker on the inner margin of the border; interrupted on the posterior margin by a broad pale median line. Metathorax with broadly rounding sides, diverging posteriorly; three hairs in the posterior angles; one long and one short hair on the posterior margin each side of the long, acute, median angle; lateral margins bordered with dark golden brown, darker on the inner margin. Legs pale fuscous with narrow dark marginal bands. Sternal markings consisting of pale fuscous intercoxal markings and a distinct median sternal blotch.

Abdomen narrow, elliptical; sides of the middle segments parallel; posterior angles with from one to two hairs; four dorsal hairs on the posterior margins of the segments, two near the middle and one each side near the lateral margin; transverse bands fuscous; lateral bands deep golden brown, broader anteriorly and extending beyond the suture into the segment in front; segments 2-6 with a pale posterior border; segments

7 and 8 with pale longitudinal median band; last segment narrowly rounding, with a narrow emargination; one short hair on the posterior margin, each side of the emargination; ventral surface with broad transverse median blotches.

Male. Body, length 1.5 mm., width .4 mm.; head, length .46 mm., width .34 mm.; distinctly shorter than the female; abdomen more broadly elliptical; segments 7 and 8 narrowed distinctly in the middle; last segment broadly rounded, with ten long hairs on the posterior margin; transverse bands distinctly dark on segments 1 to 6; last segment evenly pale yellow; genitalia darker brown, extending anteriorly to segment 5.

Nirmus triangulatus Nitzsch. (Plate VI, fig. 2).

Zeitschr. f. ges. Naturwiss. (Giebel), 1866, vol. xxviii, p. 378.

Nirmus normifer Grube, v. Middendorff's Sibir. Reise, 1851, Zool. i, p. 478, pl. i, fig. 8.

Nirmus triangulatus N., Giebel, Insecta Epizoa, 1874, p. 177; Piaget, Les Pediculines, 1880, p. 201, pl. xvi, fig. 5.

Many specimens of this striking *Nirmus* from one out of two birds shot of the Pomarine Jaeger, *Stercorarius pomarinus* (Bay of Monterey, California). Our specimens differ from Piaget's figure in having the head distinctly shorter and narrower in front, giving the insect an appearance markedly different from the effect given by the figure. There is probably no doubt, however, regarding the identity of the species.

Nitzsch's specimens were taken from "*Lestris crepidata*," Grube's from "*Lestris richardsoni*," and Piaget's from *Stercorarius pomarinus* and *Larus canus* (Zool. Garden of Rotterdam).

The species may be readily recognized by the characteristic black, subtriangular, lateral, abdominal blotches, and the chestnut-brown, median, abdominal

blotches (see figure). My specimens measured: Male, body, length 1.8 mm., width .62 mm.; head, length .53 mm., width .53 mm. Female, body, length 2.1 mm., width .63 mm.; head, length .6 mm., width .6 mm.

Nirmus lineolatus var. **atri-marginatus**. Kellogg and Chapman (For *lineolatus* see Kellogg, New Mallophaga, I, 1896, p. 113, pl. vi, figs. 7, 8 and 9).

Many specimens from *Larus canus*, *vega*, *brachyrhynchus* and *Rissa tridactyla pollicaris* (Bay of Monterey, California). A readily recognized variety of *lineolatus*, characterized by the presence of black temporal borders, usually strongly marked, sometimes weakly so. Other characters those of *lineolatus*.

Nirmus punctatus Nitzsch. (See Kellogg, New Mallophaga, I, 1896, p. 109, pl. vi, figs. 1 and 2).

Specimens from *Larus delewarensis* (Bay of Monterey, California). Taken previously by Kellogg from *Larus occidentalis* (same locality).

Nirmus gigantica Kellogg.

New Mallophaga, I, 1896, p. 105, pl. v, fig. 6.

Many specimens from a Short-tailed Albatross, *Diomedea albatrus*, and a single specimen from a Dark-bodied Shearwater, *Puffinus griseus* (Bay of Monterey, California). Described from *Diomedea albatrus* (same locality).

Nirmus complexivus n. sp. (Plate VI, fig. 3).

Many taken from the Sanderling, *Calidris arenaria* (Pacific Grove, California); found on every one of fifteen birds shot, and two specimens from a Least Sandpiper, *Tringa minutilla* (Palo Alto, California). This

form belongs to the group *zonati*, of Piaget (Les Pediculines p. 187) and shows but slight differences from several of the species of this group already described, one or two from the same host, indeed; but on the other hand Nitzsch's and Piaget's species differ among themselves but little, and the American specimens differ quite as much from any described species. In fact they are interesting as showing a combination of several characters which are presented as diagnostic of *cingulatus* (the interrupted first abdominal band), *zonarius* (the hairs and spines of the temples, and the head longer than wide), and *scalaris* (the size). In addition they present characters (metathoracic hairs, *et al.*) which are not shown by any one of the described species. I describe the American form therefore as a new species. The group needs revision; probably four or five of the present species should be reduced to varieties of the oldest named form, i. e. *cingulatus*.

Description of the female. Body, length 1.71 mm., width .5 mm.; readily distinguishable by its general dark color, and rounding, uncolored clypeus with the distinct colored signature, on each side of which lie the narrow triangular projections of the anterior ends of the antennal bands; the posterior ends of the antennal bands bend so strongly in at the suture that they mark the fore part of the head off from the hind part into a small cone.

Head, length .4 mm., width .34 mm.; elongate, triangular, with clypeus broadly rounding, the uncolored region slightly expanded beyond the suture; two short hairs on the rounding margin of the uncolored clypeus, one rather long hair in front of the trabeculæ; trabeculæ prominent, angular, reaching beyond the first joint of the antennæ; antennæ short, reaching barely two-

thirds of the distance to the occipital margin, pale fulvous with darker, broad annulations; segment 5 half as long again as segments 3 or 4; eyes distinct, with a hair and an ocular fleck; temples broadly rounding, with three long pustulated hairs, one short hair, and one prickle on the margin; occipital margin straight; clypeal signature constricted anteriorly, with the posterior, lateral angles projecting slightly backward; the posterior angle extending back indistinctly to the mandibles; antennal bands conspicuous, blackish brown, extending into long, paler, triangular projections on the clypeus; the blackish posterior ends extending in, meeting on the median line; ocular blotches contiguous with the dark temporal borders; occipital bands very definite, looking like two dark bars, bending outwards towards the ocular blotch but fading into the dark chestnut-brown of the temples; occipital blotch distinct; a pale transverse space behind the bent antennal bands, running like a curving bar across the head from margin to margin; occipital signature dark fuscous, spear-head-shaped.

Prothorax short, sides rounding; lateral quadrangular blotches separated by a narrow uncolored median line; lateral margin distinctly bordered with dark brown. Metathorax with strongly rounding sides; a short prickle in the anterior angle, a short prickle and a long pustulated hair near the middle of the lateral margin, two long pustulated hairs and two shorter hairs in the posterior angles, two short hairs on the posterior margin; the posterior margin rounding slightly upon the abdomen; strong, dark lateral bands. Legs light fulvous with dark marginal bands. Sternal markings consisting of intercoxal lines extending backward to the tip of the coxa of the second pair of legs;

a median sternal blotch rounding posteriorly with a sharp constriction about midway to the arrow-headed anterior portion.

Abdomen elongate, with one or two slender hairs in the posterior angles of the segments, two strong, pustulated hairs in the posterior margins of the segments; abdomen dark fulvous brown with broad, ill-defined, darker lateral bands, and a transverse linear band along the posterior margin of each segment of a darker brown, adjacent to which are the small uncolored stig-matal spots; the uncolored sutural lines distinct; segment 1 has the transverse band divided by a narrow uncolored median line; segments 8 and 9 more evenly colored; last segment angularly emarginated, with two anal blotches; two short hairs on the posterior margin each side of the emargination.

Nirmus actophilus n. sp. (Plate VI, fig. 4).

Many specimens from nine out of fifteen individuals shot of the Sanderling, *Calidris arenaria* (Bay of Monterey, California). A member of Piaget's group *obscurusuturati* (Les Pediculines, p. 169) and resembling somewhat *inaequalis* (ibid., p. 176, pl. xv, fig. 1) from *Numenius arquata*.

Description of the female. Body, length 1.59 mm., width .4 mm.; pale, with distinct, narrow, lateral bands of dark brown to black, head darker brown than the thorax, with dark narrow marginal markings.

Head, length .37 mm., width .28 mm.; conical, but little wider through the temples; clypeus broadly rounded, with four marginal hairs, three on the front before the suture, and one long one before the trabeculae; also a short prickle just at the angle of the trabeculae; a dorsal hair between the two anterior marginal hairs,

two other dorsal hairs on each side near the anterior extremity of the incurving antennal bands; trabeculae distinct, reaching nearly to the end of the first segment of the antennae; antennae with segment 2 longer than segment 1, and segment 5 longer than segments 3 or 4; color pale fulvous, slightly darker on the last three segments, sutures uncolored, lateral margins slightly darker fuscous; eyes not conspicuous, flattened, with a fine hair and a short prickle; temporal margins slightly rounded, with one long weak hair, one very short hair, and three short prickles; occipital margin concave; clypeal markings distinct, marginal; signature short, distinct anterior margin fading into a broadly rounded posterior angle; behind the signature a transverse linear uncolored space, continuous with the clypeal sutures, forming a distinct uncolored transverse bar across the forehead; antennal bands well defined, bending forward at the clypeal suture into broad, quadrangular ends, posterior extremities bending backward nearly to the distinct ocular blotches, which meet posteriorly the anterior ends of the narrow black temporal borders; occipital blotches small; a distinct, elongate, oval, occipital signature showing through from the ventral side; the mandibles distinctly showing through the head, the oesophageal sclerite showing faintly.

Prothorax with flatly rounded lateral margins, each posterior angle with one pustulated hair; general color pale brown to whitish, with narrow dark lateral bands. Metathorax expanded posteriorly, angles extended, with three long pustulated hairs, and some short weak hairs in the angle and along the lateral third of the posterior margin; posterior margin slightly angulated on the abdomen; narrow black submarginal markings, broadening but less definite on the anterior angles; intercoxal

lines, and a narrow, lanceolate, median, sternal blotch showing through. Legs of an even fuscous, first pair lighter than the second or third pair.

Abdomen elongate, slightly attenuated anteriorly; segments 8 and 9 tapering rapidly; posterior angles acute, each containing from one to three hairs; dorsal surface with a few hairs, four on the posterior margins of segments 1 to 7, two near the middle and two near the lateral margins; ground color pale fawn, gradually growing darker posteriorly, with dark brown lateral bands which send out from their anterior half an indefinite line that partially surrounds the stigmatal spot; segment 9 angularly emarginate, each broadly rounded angle bearing a short bristle; ventral surface with broad transverse bands of dark fawn, which give a darker tone to the paler transverse bands of the dorsal surface; a more definite series of hairs on the posterior margin of the segments than above; segment 8 with a group of three short hairs near the lateral margin.

Nirmus cordatus Osborn.

Insects Affecting Domestic Animals, Bull. 5, N. S., Div. of Ent.,
U. S. Dept. Ag., 1896, p. 228, pl. ii, fig. *a*.

One female specimen from a Great Marbled Godwit, *Limosa fedoa* (Pacific Grove, California). We had determined this to be an undescribed form, and had partially written a description when Professor Osborn's paper appeared, naming and describing the species from a single female and an immature specimen from the Hudsonian Godwit, *Limosa haemastica* (Burnett Collection, locality?). Our specimen agrees well with Osborn's description, except that it is somewhat larger, being 2.75 mm., long (Osborn's type 2.44 mm.), and 1.2

mm. wide, (Osborn's type .94 mm.); head, length .7 mm., (Osborn, .66 mm.), width .85 mm., (Osborn, .73 mm.) Osborn's figure, after a photograph, shows the characteristic outline, but we think there is also needed a figure showing the markings which are also very characteristic. The broad rounding anterior emarginations of first two transverse abdominal bands differ notably from the not uncommon narrow angular emarginations of these bands.

Nirmus incœnis n. sp. (Plate VI, fig. 5).

A single female from a Black-bellied Plover, *Squat-
arola squatarola* (Pacific Grove, California). Distinctly
different from Kellogg's *orarius* (New Mallophaga I,
1896, p. 104, pl. v, fig. 5) from *Charadrius dominicus*
(Lawrence, Kansas) or *bæphilus* (ibid, p. 107, pl. v,
fig. 7) from *Ægialitis vocifera* (Lawrence, Kansas).

Description of the female. Body, length 1.65 mm.,
width .31 mm.; strikingly elongate, narrow; head long,
with subparallel sides; pale golden brown with very
narrow blackish lateral borders on the head, thorax, and
abdomen; an ill-defined brownish band across the
head in front of the antennal bands.

Head, length .37 mm., width .21 mm.; clypeal front
broadly rounding, with three marginal hairs about
equally distant apart, the third just before the suture,
one hair arising from the dorsal surface, extending be-
yond the lateral margin of the head, a short fine hair
in front of the small acuminate trabeculæ, antennæ
short, segment 2 longer than segment 1, and segment
5 longer than segments 3 or 4; eye flat, with a
prickle near its posterior angle; temples with sides
parallel, with one long hair, one short fine hair, and
one short prickle on the margin; occipital margin

straight and bare; general color of the head golden brown, a narrow, irregular, marginal border on the clypeal front, darker on the inner margin; a weak brown band across the head in front of the antennal bands, which are narrow and distinctly dark golden brown; small ocular blotches and temples with very narrow dark brown borders.

Prothorax quadrangular, with rounding, posterior angles, each with one hair; transverse blotches golden brown, darker on the lateral margins and in the anterior and posterior angles; a broad, pale, median line separating the transverse blotches. Metathorax more than twice as long as the prothorax, and as wide as the head; sides diverging but little; a slight constriction near the anterior angles; a series of hairs on the rounding posterior margin; same golden brown as the prothorax, a narrow marginal border and a small brown spot in the anterior angles, a narrow but well defined border on the posterior half of the metathorax, the anterior ends bending in, making the slight constriction appear more than it really is. Legs paler golden brown than the thorax, with very narrow marginal borders of dark brown.

Abdomen narrow, elongate, with parallel sides, not tapering till segment 7; segment 1 narrower and shorter than those that follow; posterior angles but little extended, with one or two fine hairs; four long pustulated hairs on the posterior margins of the segments; transverse bands on segments 2 to 8 are golden brown, darkening towards the lateral margins where the lateral band is dark, narrow, and clearly defined; segments 7 to 9 without lateral bands; a pale transverse median band, caused by the uncolored stigmatal spots, thus the transverse blotches appear like two dark bands across each

segment; segment 9 narrowly emarginate, with two pale brown blotches.

Nirmus opacus n. sp. (Plate VI, fig. 6).

Several specimens from two individuals of the Semipalmated Plover, *Ægialitis semipalmata* (Pacific Grove, California). The new species belongs to the group *bicuspidati* (Piaget, Les Pediculines, p. 184), being in size, outline and marking much like *bicuspis* N. (Giebel, Insecta Epizoa, p. 155, pl. v, figs. 11 and 12; Piaget, Les Pediculines, p. 184, pl. xv, fig. 7) from "*Charadrius minor*," *C. hiaticula* and *Recurvirostra avocetta*.

Description of the male. Body, length 1.11 mm., width .47 mm.; body dark colored all over, with narrow black lateral abdominal bands.

Head, length .4 mm., width .31 mm.; elongate-conical, with broad, rounding front; uncolored clypeal region slightly expanded in front of the suture; five marginal hairs, one in the rounding anterior angle, one just behind this, one at the suture, and two before the trabeculæ; a few dorsal hairs project beyond the margin; trabeculæ distinct, rather slender, acute, prominent for *Nirmus*; antennæ short, not reaching the occipital margin when projected backward, segment 2 longest, segments 3 and 4 short, subequal, segment 5 longer, concolorous with ground color of the head; eyes flat, with a long hair and a fine prickle; temporal margins flatly rounding, with two long hairs and two prickles; occipital margin straight; front of clypeus uncolored; signature large, colored, shield-shaped, from its posterior point a narrow uncolored line runs backward to the mandibles or beyond; antennal bands distinct, blackish brown, interrupted at suture, the part behind the suture curving, with anterior extremity

expanded; hind head separated from fore head by an angulated, rather broad pale transversal space; temples unevenly bordered with blackish brown..

Prothorax quadrangular, with posterior angles nearly rectangular, with one long hair; brown with blackish, even, lateral borders. Metathorax pentagonal, angulated on abdomen; lateral angles with one short hair and three long pustulated hairs, and two long pustulated and one short pustulated on each postero-lateral margin; brown, darker in anterior angles. Legs concolorous with palest color of the thorax, and with narrow dark dorsal margining. Sternal markings composed of distinct intercoxal lines, a linear median blotch on prothorax and a more distinct, larger median blotch on metathorax.

Abdomen elongate-elliptical; posterior angles of segments projecting slightly, with three or four longish hairs beginning with segment 3; dorsal hairs of segment 1 arranged as follows: two on each side of the median line (one in the inner anterior and one in the inner posterior angle of each lateral blotch); segment 2 with four pustulated hairs along the posterior margin; segments 3 and 4 with six pustulated hairs on posterior margin; segments 5 and 6 with two pustulated hairs near the middle of the posterior margin, and a very long hair on the posterior margin near the posterior angles; segment 8 with six pustulated hairs along the posterior margin; segment 9 with eight dorsal hairs and four long marginal hairs; dark brown, with distinct narrow black lateral bands; a narrow uncolored median line reaching nearly to posterior margin of segment 2; the dark brown transverse blotches on segments 6-8 broadly emarginated posteriorly; segment 9 with elongate-elliptical transverse lateral blotches meet-

ing on the median line (there are four pustulated hairs on each blotch); genitalia distinct, extending to posterior margin of segment 4.

Female. Body, length 1.75 mm., width .45 mm.; head, length .47 mm., width .28 mm. Metathorax with but two pustulated hairs on each postero-lateral margin; the narrow uncolored median line extends entirely through segment 2, and slightly into segment 3; segments 3-6 with four pustulated hairs on posterior margin, segment 7 with two median pustulated hairs on posterior margin, and segment 8 with two pustulated hairs in the rounding posterior angles; segment 9 deeply, angularly emarginated, the acute joints with a short prickle.

Nirmus fuscus Nitzsch. (See Kellogg, New Mallophaga, II, 1896, p. 499, pl. lxvii, fig. 7).

Specimens from the Western Goshawk, *Accipiter atricapillus striatulus* (Pullman, Washington), the Desert Sparrow Hawk, *Falco sparverius deserticolus* (Palo Alto, California), the Western Red-tailed Hawk, *Buteo borealis calurus* (Palo Alto, California), and the White-tailed Kite, *Elanus leucurus* (Palo Alto, California). Taken previously by Kellogg from *Buteo swainsoni*, *Circus hudsonius* and *Archibuteo lagopus sancti-johannis*, all from Lawrence, Kansas. Recorded by Osborn from *Buteo swainsoni* (Ames, Iowa), and from *Accipiter velox* (locality?).

These specimens combine characters of *fuscus*, *rufus*, *et al.* of Nitzsch, so as to lead us to doubt the distinctness of these various species of Nitzsch. We have with *Nirmus fuscus*, *sens latus*, of the hawks, a repetition of the condition shown by *Docophorus communis* of the passerine birds.

Nirmus vulgaris Kellogg.

New Mallophaga, II, 1896, p. 496, pl. lxvii, fig. 5.

Many specimens from numerous species of passerine birds. This *Nirmus* must be treated like *Docophorus communis*, in that we must group together under one specific name forms rather variant (notably in length and intensity of coloration), without being able as yet to distinguish categorically these variations. Osborn's *pallidus* (Insects Affecting Domestic Animals, 1896, Bull. 5, N. S., Div. of Ent., U. S. Dept. Ag., p. 227). from *Zamelodia ludoviciana* (Ames, Iowa) is probably based on palely colored specimens of this species. The name *N. pallidus*, by the way, is preoccupied (see Piaget, Les Pediculines, 1880, p. 144).

We refer to this species specimens from the Western Blue Grosbeak, *Guiraca caerulea eurhyncha* (4 birds, California); the Western Lark Sparrow, *Chondestes grammacus strigatus* (Ontario, California); the House Finch, *Carpodacus mexicanus frontalis* (Ontario, California); the California Towhee, *Pipilo fuscus crissalis* (2 birds, Palo Alto, California); the Spurred Towhee, *Pipilo maculatus megalonyx* (Palo Alto, California); the Golden-crowned Sparrow, *Zonotrichia coronata* (Palo Alto, California); the Lazuli Bunting, *Passerina amæna* (Palo Alto, California); the Mountain Chickadee, *Parus gambeli* (El Dorado county, California); the Californian Chickadee, *Parus rufescens neglectus* (Palo Alto, California); the Western Bluebird, *Sialia mexicana occidentalis* (Palo Alto, California); the Yellow Warbler, *Dendroica aestiva* (Palo Alto, California); the Lutescent Warbler, *Helminthophila celata lutescens* (Palo Alto, California); the Black-chinned Hummingbird, *Trochilus alexandri* (Ontario, California); the Blue-fronted Jay, *Cyanocitta stelleri frontalis* (King's River

Cañon, California); the American Dipper, *Cinclus mexicanus* (Ontario, California); the Western Flycatcher, *Empidonax difficilis* (2 birds, Ontario, California), and the Ash-throated Flycatcher, *Myiarchus cinerascens* (Ontario, California). The specimens from the two last-named bird species, Flycatchers, show a common variation from the type specimens in a greater length, less angulated posterior margin of metathorax, and paler markings. Taken previously by Kellogg from eight species of passerine birds.

Nirmus fœdus n. sp. (Plate VI, fig. 7).

Specimens from the Ash-throated Flycatcher, *Myiarchus cinerascens* (Ontario, California), the Long-tailed Chat, *Icteria virens longicauda* (Ontario, California), Say's Phoebe, *Sayornis saya* (Ontario, California), the Arkansas King-bird, *Tyrannus verticalis* (Ontario, California), the California Shrike, *Lanius ludovicianus gambeli* (Ontario, California) and the Phainopepla, *Phainopepla nitens* (Ontario, California). This species belongs to Piaget's second group of *circumfasciati*, and resembles *platyclypeatus* P. and *frater* (Les Pediculines, p. 145, pl. xii, figs. 1 and 2) from *Motacilla alba* and *Lamprotornis amethystina*, respectively.

Description of the female. Body, length 2.21 mm., width .75 mm.; abdomen broad for *Nirmus*, pale fuscous, head darker than the thorax or abdomen, narrow dark lateral borders on the head and thorax, but no dark lateral abdominal bands; pale brown median, transverse abdominal blotches.

Head, length .56 mm., width .43 mm.; clypeal front varying from narrowly to broadly parabolic, with four short hairs on the margin, a short marginal prickle before the trabeculae, and two long dorsal hairs

arising before the trabeculæ, which are small, yet distinct; antennæ short, segment 2 longer than the other segments, segment 5 longer than segments 3 or 4, a few short hairs on the segments; eye distinct, with one very long hair and a short prickle at its posterior angle; temples rounded, with two long marginal hairs and two or three short prickles; occipital margin straight; head of a general dark fulvous, clypeal front paler, clearer yellow brown; antennal bands very narrow, blackish brown, strictly marginal and not extending far anteriorly; antennæ an even, pale fuscous; ocular blotches dark and extending angularly inward; temples with a narrow border of blackish brown.

Prothorax with sides rounding and slightly divergent, with a long hair in the posterior angle; three short dorsal spines near the anterior angle, two near the median line, and one nearer the lateral margin; lateral margins with irregular dark borders; intercoxal lines showing through from the under side distinctly, as sharply defined lines, directed in towards the median line, before the posterior margin. Metathorax but little wider than the prothorax, slightly constricted near the anterior angles; posterior angles broadly rounded, with one short hair and one spine; posterior margins nearly straight on the abdomen, except for the acute median angle; a series of long pustulated hairs on the posterior margin each side of the acute angle. Legs pale fuscous without definite markings.

Abdomen broadly elliptical; angles of segments not projecting, a series of long hairs on the posterior margin of the segments; transverse bands an even, pale fuscous, indistinct to wanting, without darker lateral bands; last segment broadly rounding, with slight emargination, two or three short marginal hairs and

several long dorsal hairs; ventral surface with broad median transverse bands of dark fuscous; blotches of the last segment posteriorly emarginate and laterally interrupted by the pustulations of two long hairs; these ventral blotches show through above.

Nirmus ductilis n. sp. (Plate VI, fig. 8).

One female from a Western Flycatcher, *Empidonax difficilis* (Ontario, California). A member of the group *interrupto-fasciati*, but well distinguished by its sharp, distinct, blackish marginal markings, without trace of median abdominal blotches.

Description of the female. Body, length 1.9 mm., width .4 mm.; long, slender, transparent white, with narrow, distinct, blackish lateral margins of head and abdomen.

Head, length .37 mm.; width .28 mm.; elongate, conical, front narrow and slightly concave; a few short hairs along the margin of the front, the longest hair in front of the trabeculae, which are small but distinct and uncolored; antennae with second segment longest, segment 5 longer than segments 3 or 4, segments 1 and 2 pale transparent whitish, segment 3 with a slight shade of brown, segments 4 and 5 dark brown; eye with a prickle; temporal margins with one long hair and two or three prickles; occipital margin slightly convex; antennal bands narrow, blackish brown, fading out along the inner margins and anteriorly, before reaching the uncolored frontal margin, the posterior extremities bending angularly in, meeting the dark ocular blotches which in turn meet the dark brown marginal borders of the temples.

Prothorax with flatly rounding lateral margins and posterior angles, dark blackish brown lateral borders, which bend in and back on the anterior and posterior

extremities, the posterior borders almost meeting on the median line. Metathorax as wide as the head, sides diverging strongly; posterior angles with three or four long hairs, a series of pustulated hairs along the outer third of the posterior margin that is rounded upon the abdomen; dark, interrupted lateral blotches narrow and marginal on the anterior angles, and large, irregular submarginal blotches, darker near the posterior angles, growing paler near the middle. Sternal markings consisting of distinct intercoxal lines and a pale brown median blotch on the metasternum. Legs translucent whitish with blackish brown marginal bands and semi-annulations.

Abdomen very long, elliptical, with subparallel sides not tapering posteriorly until after segment 7; posterior angles of the segments slightly projecting, each bearing one weak hair, till segment 7, which has two hairs in the angle; segment 8 has one lateral marginal hair besides two hairs in the posterior angle; segment 9 broadly rounding, with angular emarginations, two short hairs on the posterior margin; two dorsal hairs arising near the posterior angle of each segment except segment 8 which has a series of posterior marginal hairs; pale translucent whitish with distinct, narrow blackish brown linear bands on the lateral margins of segments 1 to 7; segment 8 with small pale brown blotches near the lateral margin and one pale brown blotch on the median line; last segment uncolored; genital blotches pale brown, linear each side of the median line on the posterior margin of segment 7, also a pale brown blotch on the median line of segment 6.

Nirmus lautiusculus n. sp. (Plate VI, fig. 9).—

A single male from a Bell's Sparrow, *Amphispiza belli* (Ontario, California). The new species, strikingly

marked, is a member of the group *interrupto-fasciati*, in general shape like *vulgatus* K. (New Mallophaga II, p. 496, pl. lxvii, fig. 5) and with the characteristic angulated, colored internal border of the antennal fossa. In the distinctness and contrast of the markings it recalls *illustris* K. (New Mallophaga II, p. 494, pl. lxvii, fig. 4).

Description of the male. Body, length 1.65 mm., width .4 mm.; translucent whitish with sharp, black, narrow marginal bands on head and abdomen; legs with annulations and semiannulations; thorax with intercoxal lines showing through distinctly, and abdomen with median linear brown transverse blotches, two to a segment, on ventral aspect.

Head, length .34 mm., width .31 mm.; front narrow, slightly convex; two or three short hairs on the lateral margin of the front; a short prickle in front of the trabeculæ which are distinctly angular and uncolored; antennæ long; segment 2 longer than other segments, segment 5 distinctly dark brown; eye prominent, with two prickles, one on the eye itself and a second just at its posterior angle; temples rounding, with one very long hair, one short fine hair, and three short prickles; occipital margin straight and bare; antennal bands narrow, clearly defined, not fading inwardly, their anterior extremities separated by the uncolored clypeal front, interrupted just before the trabeculæ by a distinct uncolored space, posterior extremities acutely meeting the dark narrow bands that angularly margin the antennary fossæ and the eye; the temples irregularly dark on the margins; the occipital signature distinctly showing through as a narrow brown blotch on the occipital margin and in front as a triangular blotch.

Prothorax with rounding lateral margins and posterior angles; three short spines on the dorsal surface

in each anterior angle; a dark blackish brown blotch in the anterior angles, and a narrow black band along the posterior margin, widening as it reaches the angle. Metathorax longer than the prothorax, with sides diverging; a series of six long hairs on the posterior margin which is narrowly rounded upon the abdomen; anterior angles with a small blotch of dark brown. Sternal markings showing through distinctly, the intercoxal lines of the metasternum appearing as a dark transverse band across the metathorax, the lateral extremities not reaching the margin but bending irregularly backward, abruptly stopping before they reach the posterior angle. Legs translucent with dark annulations and semiannulations.

Abdomen narrowly elongate, segments 1-7 with narrow, sharply defined black lateral bands; last segment uncolored, narrowly rounding, with several long dorsal hairs; the ventral surface of segments 1-6 with two median, linear brown transverse blotches on each segment; these blotches are united on segment 6 by a brown median line; segment 7 with two longitudinal brown blotches each side of the median line approaching each other anteriorly; two very small brown blotches on the last segment near the anterior angle.

Nirmus longus Kellogg.

New Mallophaga, II, 1896, p. 490, pl. lxxvii, fig. 1.

A single male from the Barn Swallow, *Chelidon erythrogastra* (Palo Alto ? California). This specimen differs distinctly from the type specimens in having but three instead of six lateral metathoracic hairs, in the more elongate head, and in the distinctness of the median uncolored longitudinal line of the abdomen. It should be distinguished by a varietal name.

Var. *domesticus* Kellogg and Chapman; one male from the Barn Swallow, *Chelidon erythrogastra* (California); body, length 1.54 mm., width .41 mm.; head, length .37 mm., width .31 mm.; thus being of about same size as the species type, and twice as long as Nitzsch's *gracilis*, the common *Nirmus* of the European swallows. Characters of species with differences as noted above. Osborn (Insects Affecting Domestic Animals, 1896, p. 225) refers a specimen from the Purple Martin, *Progne subis* (Ames, Iowa), to *gracilis*. He does not give the measurements of his specimen.

Nirmus brachythorax Giebel.

Insecta Epizoa, 1874, p. 134.

Nirmus brachythorax G., Piaget, Les Pediculines, 1880, p. 150, pl. xii, fig. 8; Osborn, Insects Affecting Domestic Animals, Bull. 5, N. S., Div. of Ent., U. S. Dept. Ag., 1896, p. 223.

Specimens from two Cedar Waxwings, *Ampelis cedrorum* (Palo Alto, California). Osborn's specimens were from same host (Ames, Iowa). Giebel's types are from same host.

Lipeurus.

Lipeurus laculatus n. sp. (Plate VII, fig. 1).

Four specimens collected of this strikingly marked *Lipeurus*; an adult male and an immature individual from a Pomarine Jaeger, *Stercorarius pomarinus*, and an adult male and an immature from a Pink-footed Shearwater, *Puffinus creatopus* (Bay of Monterey, Calif.) We believe that the specimens from the Shearwaters are stragglers from the Jaeger. (We have examined so many Shearwaters that, were the species a regular parasite of *Puffinus*, we should have taken other examples.) One other individual of *Stercorarius pomarinus* was

examined, but no *Lipeurus* was found on it. The new species shows no special resemblances to any of the described *Lipeuri* of allied hosts.

Female. Body, length 4.06 mm., width .78 mm.; slender, transparent whitish with distinct black marginal markings on the head, thorax, legs, and abdomen, broad transverse bands of dark chestnut showing through the dorsal surface of the abdomen.

Head, length 1. mm., width .59 mm.; elongate, conical, sides nearly parallel, clypeal front rather narrowly rounded, with five marginal hairs, four of which arise from the anterior part of the clypeus, being about equidistant, the fifth hair is in front of the very small trabeculæ; two dorsolateral hairs, one near the first anterior marginal hair and the other between the third and fourth marginal hairs; antennæ with segment 2 longer than the other segments, segments 1, 2 and 3 uncolored, segment 4 dark brown, segment 5 lighter brown; eye distinct, with a short prickle; temporal margins nearly parallel, with one hair and four short prickles; anterior margin of the clypeus uncolored; a wide, distinct signature with convex, posterior margin; color even chestnut-brown; antennal bands broad, black, sharply defined, except at the anterior portion where they extend indistinctly toward the median line of the head; temporal margin distinctly bordered with black, narrowing posteriorly; occipital blotches black and angular.

Prothorax quadrangular, sides parallel; a short prickle in the posterior angles; pale transparent brown, with broad black lateral borders following the margins of the anterior and posterior angles. Metathorax longer than broad, widest at the posterior angles; posterior margin straight; ground color slightly darker brown

than the prothorax, with irregular, black marginal bands fading just back of the anterior angles, and with an emargination at their posterior extremity where four long pustulated hairs and one short hair arise; one short hair on the posterior angle. Legs concolorous with the pale color of the prothorax, with black annulations and marginal bands; front legs short, femora wide, with small black marginal markings; second and third pair of legs long; coxæ produced and widely separated, with dark dorsal annulations; femora long and slender, with narrow black marginal markings; tarsi and claws pale brown; several scattered hairs and spines on the legs. Sternal markings composed of intercoxal lines between pro- and mesolegs, and a large suboblong, metathoracic, median blotch with rounded angles.

Abdomen with sides of segments 1-7 parallel; segments 8 and 9 suddenly narrowed and very small; posterior angles of the segments with from one to four long hairs; segment 9 narrowly emarginate, with two long hairs on each of the posterior angles; ground color transparent whitish, with black lateral marginal bands which extend inward along the anterior and posterior margins; these lateral bands are inwardly emarginated by an uncolored space surrounding the stigmata; on the ventral aspect fulvous transverse bands, concave posteriorly; segment 7 with two longitudinal, lateral fulvous blotches; segment 8 with irregular black marginal bands; segment 9 wholly dark brown to black.

***Lipeurus diversus* Kellogg.**

New Mallophaga I, 1896, p. 123, pl. viii, figs. 3 and 4.

Many specimens from thirteen out of thirty-four individuals shot of the Black-vented Shearwater, *Puffinus*

opisthomelas, from twelve out of fourteen individuals shot of the Dark-bodied Shearwater, *P. griseus*, from five out of six individuals shot of the Pink-footed Shearwater, *P. creatopus*, from a single specimen shot of *P. bulleri*, from a single specimen shot of *P. tenuirostris*, and a single specimen, probably straggler, from a Short-tailed Albatross, *Diomedea albatrus* (all the birds from the Bay of Monterey, California). The species was described from *Puffinus opisthomelas* (same locality).

This species and *Lipeurus angusticeps* Piaget (Les Pedieulines, p. 306, pl. xxv, fig. 4) from *Thalassidroma leachi*, and *Lipeurus abnormis* Piaget (Supplement, p. 65, pl. vii, fig. 2) from *Puffinus major*, are closely related. There is a regular sequence in size from *angusticeps* through *diversus* to *abnormis*. It may be suspected that we have to do with one species of great variation in size; but the diagnostic characters of the three species are sufficiently important to justify the separation of the forms.

Lipeurus densus Kellogg.

New Mallophaga II, 1896, p. 114, pl. vii, figs. 1 and 2.

Two females and a male from a Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). Types taken from *Diomedea albatrus* and *D. nigripes* (see Kellogg, Mallophaga from Birds of Panama, Baja California and Alaska, in New Mallophaga III, p. 28, pl. iii, fig. 2). These specimens fully confirm the specific identity of the female described in New Mallophaga II, p. 114, and the male described in New Mallophaga, III, p. 28. The females now taken are almost, if not quite, as large as the male, and they are also quite as fully blotched and colored.

Lipeurus ferox Giebel. (See Kellogg, New Mallophaga, I, 1896, p. 127, pl. ix, figs. 1 and 2).

One male from the Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). Previously taken by Kellogg from same host species (same locality). The description and figure which Taschenberg (Die Mallophagen, 1882, p. 145, pl. v, fig. 1 a) gives for the female of *Lipeurus ferox* apply in reality, we believe, to the male of *Lipeurus densus* Kellogg (See Mallophaga from Birds of Panama, Baja California and Alaska, in New Mallophaga, III, 1899, p. 28, pl. iii, fig. 2).

Lipeurus concinnus n. sp. (Plate VII, fig. 2).

A male and a female from the Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). A slender, graceful form of the *clypeati sutura indistincta*, not much resembling any of the *Lipeuri* hitherto taken on the Albatross.

Description of the male. Body, length 3. mm., width .53 mm.; slender, pale, with distinct black marginal markings, and brown head and transverse abdominal blotches.

Head, length .65 mm., width .4 mm.; elongate, conical, front rounded, four long marginal hairs and one short one before the antennal angle; a long hair, arising from the dorsal surface between the first and second marginal hairs, extends beyond the margin; antennæ with segment 1 nearly as long as all the other segments, segment 2 about one-third as long as segment 1, segment 3 short, with a dorsal, angular, distal appendage, segment 5 longer than segment 4, segments 4 and 5 and the tip of the appendage of segment 3 light brown, antennæ elsewhere uncolored; eyes distinct but not

protruding; temples convex, hind-head widest about half way between the eyes and the posterior angles; margin with no long hairs, but with a short curving hair and a few prickles; occipital margin straight; head all brown, except small, nearly uncolored part of clypeal front, and antennæ, of which the first three segments are uncolored, last two pale brown; narrow marginal antennal bands; small signature, widest anteriorly and extending posteriorly in a fading, acuminate point; indistinct occipital bands and temporal borders blackish; anterior horns of the prothorax showing through, producing the effect of black triangular blotches at the base of the occipital bands.

Prothorax quadrangular, straight in the middle third on the metathorax; one very short hair in the posterior angle; general color transparent whitish, with distinct, even black lateral borders. Metathorax with lateral margins slightly convex before the middle; longer than broad; posterior margin slightly angulated upon the abdomen; three long hairs and two shorter hairs in the posterior angles; general color pale transparent brownish, with irregular lateral bands of black, expanding near the anterior angles into conspicuous triangular blotches, narrower below these blotches than the lateral bands of the prothorax. Legs long, slender, transparent, with black bands on femora and tibiæ; tibiæ and tarsi brown, a few scattered hairs on the legs. Prosternum with curving intercoxal lines; a medial, metathoracic, sternal blotch oblong, darker on the posterior half.

Abdomen slender, elongate, slightly widening to segment 4, then tapering gradually to segment 9; segment 2 longer than the other segments, while segments 4 and 5 are narrow, especially in the middle; posterior angles

but slightly extending, with from one to four hairs; segment 8 with six long posterior marginal hairs; general ground color of the abdomen, after segment 1, which is transparent whitish, dark brown; lateral markings black, of segment 1 they are anterior and angular, of segments 2 to 7 broadly extending towards the median line on the anterior half of the segments, while the posterior portion is darker and more definitely angular, this lateral band is deeply emarginated interiorly by a light brown blotch; the broad transverse bands are darker on the anterior margin, and the posterior margins of these transverse bands are emarginated by a pale brown band; segment 8 an even brown with very narrow dark lateral bands; segment 9 very small, rounding, of an even brown, with two long and two short hairs on the posterior margin.

Female. Body, length 3.63 mm., width .68 mm.; head, length .68 mm., width .43 mm.; first and second segments of antennæ nearly equal and as long as the other three segments, segment 5 longer than segment 4, segments 4 and 5 slightly colored with brown; eyes larger and more prominent than in the male; segments of the abdomen more nearly equal than in the male; segments 8 and 9 suddenly narrower than segment 7; segment 8 with a strong conspicuous hair in each anterior angle; six hairs along the posterior margin and eight small hairs in a transverse curving line on the ventral aspect; segment 9 with one hair in each anterior angle and two strong hairs on each of the two obtuse points, separated by the angular emargination of the posterior margin. Abdominal markings limited to dark brown to black, lateral blotches with pale, indistinct stigmatal spots; segments 7 to 9 almost wholly brown, with a narrow, distinct, uncolored median line; lateral parts of segment 7 blackish brown.

Lipeurus testaceus Taschenberg. (See Kellogg, New Mallophaga, I, 1896, p. 130, pl. xi, figs. 2 and 4).

A few specimens, rarely more than one or two from a bird, from eight out of thirty-four individuals shot of the Black-vented Shearwater, *Puffinus opisthomelas*; not found on any one of fourteen individuals shot of *P. griseus*; found on one out of six individuals shot of *P. creatopus*; and not found on the single specimen examined of *P. bulleri*, nor of *P. tenuirostris*, all from the Bay of Monterey, Calif. Taken previously by Kellogg from *Puffinus opisthomelas*, same locality. We have no males among the few specimens collected.

Lipeurus limitatus Kellogg.

New Mallophaga, I, 1896, p. 124, pl. viii, figs. 5 and 6.

Many specimens from five out of thirty-four individuals shot of the Black-vented Shearwater, *Puffinus opisthomelas*; from five out of fourteen individuals shot of *P. griseus*; from none out of six individuals shot of *P. creatopus*; from a single individual shot of *P. bulleri*, and from a single individual shot of *P. tenuirostris*, all from the Bay of Monterey, California. Described from three females from *P. griseus*, same locality. We are unable to find any males among our rather many specimens.

Lipeurus fuliginosus Taschenberg. (Plate VII, fig. 3).

Die Mallophagen, 1882, p. 156, pl. iv, fig. 3.

Numerous examples from the Shearwaters, *Puffinus opisthomelas* and *creatopus* (Bay of Monterey, California). Taken from eight out of thirty-four birds shot of *opisthomelas*, from one out of six birds shot of *creatopus*, and not found on any one of fourteen birds shot of *griseus*. The American specimens differ from the types

of *fuliginosus*, which were collected from *Diomedea exulans* and *chlororhyncha* by being larger, by showing no difference in the clypeal front of male and female, by having no short hair in the eye, and in other minor characters. We make a variety, therefore, for them.

Var. *major* Kellogg and Chapman. (Plate VII, fig. 3). In the following table of dimensions the figures enclosed in parentheses are the measurements given by Taschenberg for the type specimens. Male. Body, length 3.75 mm. (3.32 mm.), width .9 mm. (.58 mm.); head, length 1. mm. (.89 mm.), width .66 mm. (.55 mm.) Female. Body, length 3.9 mm. (3.72 mm.), width .94 mm. (.66 mm.); head, 1.05 mm. (.9 mm.), width .7 mm. (.59 mm.). From these measurements the head of the variety is proportionately wider than in the type forms. The species is recognizable by its dark color and the characteristic double set of internal bands in the forehead.

***Lipeurus farallonii* Kellogg.** (Plate VII, fig. 4).

New Mallophaga, I, 1896, p. 103, pl. v, fig. 4.

Many specimes from two individuals of Brandt's Cormorant, *Phalacrocorax penicillatus* (Bay of Monterey, California). Described (as a *Nirmus*) from a single female from a Farallon Cormorant, *Phalacrocorax dilophus albociliatus* (Bay of Monterey, California). The finding of the males of this species shows that it is a *Lipeurus* of the group *clypeati sutura distincta* and allied to Piaget's *setosus*, *sub-setosus*, *et al.* taken from various cormorants. The marked difference in size, outline and marking of the two sexes is striking, and likely to be confusing to students who may happen to meet but one sex. Is it possible that Piaget's *Nirmus dispar*, which the female of *farallonii* resembles, can be the female of some one of these *Lipeuri* of the cormorants?

Description of the male. Body, length 1.72 mm., width .36 mm.; head, length .43 mm., width .37 mm.; head like female, perhaps a little narrower, comparatively, behind; antennæ with segments 1 and 2 rather large, subequal, segments 3 and 4 very small, subequal, and segment 5 as long as 3 and 4 together, no distinct appendage; metathorax with sides nearly parallel, not plainly divergent as in female; abdomen slender, sides subparallel, ground color pale golden with wide whitish transverse sutural bands and prominent brown, shining subcircular lateral blotches not touching the narrow, inconspicuous blackish lateral bands; last segment truncate behind, with a group of four prominent hairs on each lateral half of the margin.

Lipeurus forficulatus Nitzsch. (See Kellogg, New Mallophaga, I, 1896, p. 129, pl. ix, figs. 3, 4, 5 and 6).

Specimens from a Californian Brown Pelican, *Pelecanus californicus* (Bay of Monterey, California). Taken previously by Kellogg from same host species, same locality; and from the White Pelican, *P. erythrorhynchus* (Lawrence, Kansas.)

Lipeurus squalidus Nitzsch. (See Kellogg, New Mallophaga, I, 1896, p. 132, pl. x, figs. 6 and 7.)

Six specimens from a Shoveller, *Spatula clypeata* (Palo Alto, California). These specimens resemble very much those specimens which Kellogg collected from *Merganser serrator* (see New Mallophaga, I, p. 130, pl. x, fig. 1). In fact, we fail to make out any good distinction between the species *temporalis* Nitzsch (found on the Mergansers) and the species *squalidus* of *Anas* and allied ducks.

Lipeurus docophoroides Piaget. (See Kellogg, New Mallophaga, II, 1896, pl. lxviii, fig. 8).

Two female specimens from a Plumed Partridge, *Oreortyx pictus plumiferus* (El Dorado county, California). These specimens differ distinctly in the less pointed front from *L. docophoroides* taken by Kellogg from *Callipepla californica*, and in this form a link between *docophoroides* and *dissimilis* Piaget (see Kellogg, New Mallophaga, II, 1896, p. 507, pl. lxviii, fig. 7). We have given these specimens a varietal name.

Var. *californicus* Kellogg and Chapman, from the Plumed Partridge, *Oreortyx pictus plumiferus* (El Dorado county, California); clypeal front not so pointed as in the species type, but approaching the rounded front of *dissimilis* P.; without signature; all the antennal segments colored, at least slightly, instead of only the last three as in the species type; the pustulated hairs of the body very long (longer than in the typical species forms).

Lipeurus perplexus n. sp. (Plate VII, fig. 5).

Two females from a Columbian Sharp-tailed Grouse, *Pediocetes phasianellus columbianus* (Pullman, Washington), and many females, differing slightly in shape of metathorax and abdomen, from a Sooty Grouse, *Dendragapus obscurus fuliginosus* (Kings River Cañon, California). A peculiar broad, robust form of the group *circumfasciati*, with rounded front. Resembling Piaget's *L. opimus* (Supplement, p. 78, pl. viii, fig. 6) from *Turacus giganteus* (Museum of Leyden). Resembling also in general outline and characters Osborn's *Nirmus cordatus*, a specimen of which we have taken from *Limosa hamastica*. Perhaps both of these forms should be referred to the same genus. Piaget's *L. opimus*

should accompany them. Unfortunately, all of these species are represented by females only.

Description of female. Body, length 2.06 mm., width .59 mm.; short, broadly elliptical body, with short, broad head, broadly rounded in front; clear fulvous with pale golden brown lateral, transverse abdominal blotches.

Head, length .53 mm.; width .5 mm.; cordate, clypeal front broadly rounded, four short marginal hairs on the front, a short hair on the margin in front of the antennæ which are short; segment 2 of the antennæ longer than segment 1, segment 5 longer than segments 3 or 4; the anterior end of segment 3 and segments 4 and 5 pale fulvous, a few short hairs on the segments; eye prominent, a long hair rising from its dorsal surface, and with a conspicuous black fleck; temples convex, with two long hairs and two or three short prickles; occipital margin slightly concave; antennal bands slightly darker on the posterior tips and continuous as a narrow, even marginal border of pale translucent golden brown on the front; narrow, occipital blotch of pale golden brown, also a temporal border and an occipital band of the same color; mandibles dark chestnut-brown, showing through the head.

Prothorax short, lateral margins convex; one hair in the posterior angle; pale fulvous, slightly darker on the lateral margins. Metathorax with sides diverging, posterior angles rounding, with a long hair and short prickle; four hairs on the posterior margin in groups of two in small, uncolored pustulations; posterior margin with a slight angle on the abdomen; pale fulvous, slightly darker on the posterior angle; all of the thorax with a more whitish ground color than the head. Sternal markings consisting of pale intercoxal lines and a

very pale median metathoracic blotch. Legs pale fulvous with narrow dark marginal borders.

Abdomen elongate-ovate, tapering rapidly posteriorly; segments with their posterior angles slightly produced, each with from one to three hairs; a transverse series of a few long dorsal hairs near the middle of the segments; ground color pale fulvous, narrow translucent brown bands on the lateral margins; broad transverse pale brown blotches on segments 2 to 7, darker on their inner ends, separated by a broad pale median line, also a broad pale band on the posterior margin of each segment; segment 8 entirely colored, with slight median emarginations on the anterior and posterior margins of the blotch; no distinct lateral bands; last segment round, narrowly emarginate, with one short hair on the posterior margin of each rounding angle; two transverse blotches, one on each side of the emargination.

Giebelia.

Giebelia mirabilis Kellogg.

New Mallophaga, I, 1896, p. 138, pl. xi, figs. 7 and 8.

Many specimens from twenty-seven out of thirty-four individuals shot of the Black-vented Shearwater, *Puffinus opisthomelas*; from ten out of fourteen individuals shot of the Dark-bodied Shearwater, *P. griseus*; from all out of six individuals shot of the Pink-footed Shearwater, *P. creatopus*; from a single individual shot of *P. bulleri*, and from a single individual shot of *P. tenuirostris*, all from the Bay of Monterey, California. Four specimens, probably stragglers from a Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California. The species was described from *P. opisthomelas*.

Oncophorus.**Oncophorus bisetosus** Piaget. (Plate VII, fig. 6).

Les Pediculines, 1880, p. 217, pl. xviii, fig. 4.

Several specimens from the Californian Clapper Rail, *Rallus obsoletus* and the Virginia Rail, *Rallus virginianus* (Palo Alto, California). Piaget's specimens were taken from *Rallina plumbeiventris*, *R. tricolor* and *R. isabellina*. He also found specimens on a Yellow Rail, *Porzana noveboracensis* (from North America, in the Museum of Leyden). The specimens from this last bird are distinguished by the varietal name *porzanae*, being slightly larger than the type specimens and showing certain small differences in hairs and markings. Our specimens from *Rallus obsoletus* and *R. virginianus* agree with var. *porzanae* in departing in the matter of size and hairs of dorsal surface of abdominal segments from the type specimens, but go farther in differing and must be distinguished by a varietal name.

Var. *californicus* Kellogg and Chapman. (Plate VII, fig. 6). From the Californian Clapper Rail, *Rallus obsoletus* (Palo Alto, California) and the Virginia Rail *Rallus virginianus* (Palo Alto, California). (In the following list of measurements the figures in parentheses are those given by Piaget for the type specimens). Female. Body, length 1.72 mm. (1.35 mm.), width .5 mm. (.47 mm.); head, length .53 mm. (.47 mm.); width .4 mm. (.38 mm.); seven hairs on margin of forehead, of which two are longer and dorsal, instead of six with one dorsal as in the types; a prominent hair in the eye not mentioned in the description of the types; two median hairs on dorsal aspect of each abdominal segment, as in the variety *porzanae* Piaget, instead of four as in the species type. The female has large

quadrangular, transverse, lateral abdominal blotches separated by a narrow median uncolored line hardly apparent on segments 6-9; a strong uncolored transverse line between segments 7 and 8; lateral bands black, distinct, segmented. In the male the transverse abdominal blotches are continuous across the segments, with widely separating, uncolored, transverse sutures, especially on posterior half of abdomen.

***Oncophorus remotus* n. sp.** (Plate VII, fig. 7).

A male and female from a Great Gray Owl, *Scotioptex cinerea* (Pullman, Washington). Not at all like *O. heteroceras* Piaget (Les Pediculines, p. 222, pl. xviii, fig. 8) from *Strix bubo*, which has the head varying markedly in the sexes; and not like *O. hexophthalmos* Nitzsch (described by Nitzsch as a *Lipeurus* and referred by Giebel to *Ornithobius*, and by Piaget to *Oncophorus*) from *Strix nyctea*.

Description of the male. Body, length 2.02 mm., width .93 mm.; short, broad; pale golden brown, with slightly darker bands on the head and thorax.

Head, length .65 mm., width .59 mm., subpentagonal, broadly rounding in front; clypeus slightly convex, two hairs on each side of the uncolored clypeal front, a third marginal hair in front of the suture; a long marginal hair and short prickle in front of the trabeculae which are long and acutely angular; antennae with its first segment as long as all the other segments taken together, third segment with slight but appreciable distal projection, a few short spines on the segments; eye with a distinct ocular fleck and a long hair; temples with sides nearly straight, two long hairs and two prickles on the margin; occipital margin straight, without hairs or prickles; general color of the head pale

golden brown; clypeal signature very pale brown but distinct, anterior margin slightly concave; antennal bands interrupted at the suture, darker chestnut-brown at the posterior extremities, which are turned almost at a right angle with the anterior half and lie half way between the mandibles and base of the antennæ; distinct, angularly contorted, inner bands paler than the antennal bands; occipital bands pale anteriorly, growing darker and more sharply defined near the occipital margin.

Prothorax quadrangular, with rounded posterior angles, with one long hair; sternal markings showing through as dark bands near the lateral margins, bending inwardly before the posterior margin, and separated by a distinct, uncolored median line. Metathorax with convex, divergent sides, a long slender hair and a prickle on the lateral margin, near the posterior angle, three long hairs in the posterior angle; a series of hairs along the rounding, posterior margin. Legs pale brown, with a few scattered spines.

Abdomen broadly elliptical, narrowing at both extremities; a few long hairs in the posterior angles of the segments; a transverse series of hairs on the posterior margins of the segments; segments 5, 6 and 7 narrowed in the middle; last segment narrowly rounding, pointed, with two long hairs on the posterior margin; ground color very pale golden brown; transverse lateral blotches indistinct, separated by a broad uncolored median space, except on segment 5, where the transverse band extends across the entire segment; segments 6, 7 and 8 with a broad median blotch of darker golden brown; segment 9 entirely brown; there are but slight indications of defined lateral marginal bands; genitalia distinct, dark golden brown, broad and complex.

Female. Body, length 2.5 mm., width .93 mm.; head, length .71 mm., width .75 mm. The shape of the head different, the temporal margins being distinctly convex; segments 1 and 2 of the antennæ as long as segments 3, 4 and 5, but segment 2 longer than segment 1. Abdomen widely elliptical, but distinctly more elongate and less narrowed posteriorly; very pale golden brown; last segment emarginate, with rounding lateral halves.

Eurymetopus.

Eurymetopus taurus Nitzsch. (See Kellogg, New Mallophaga, I, 1896, p. 135, pl. xi, figs. 3, 4, 5 and 6).

Two females from two specimens of the Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). Previously taken by Kellogg from same host species (same locality). A single immature specimen, probably a straggler, from a Black-vented Shearwater, *Puffinus opisthomelas* (Bay of Monterey, California).

Goniodes.

Goniodes mammillatus Rudow. (See Kellogg, New Mallophaga, II, 1896, p. 509, pl. lxix, fig. 2).

Two immature specimens from a Columbian Sharp-tailed Grouse, *Pediocates phasianellus columbianus* (Pullman, Washington). Previously taken by Kellogg from *Callipepla californica* (California).

Colpocephalum.

Colpocephalum perplanum n. sp. (Plate VII, fig. 8).

One specimen from a Tufted Puffin, *Lunda cirrhata* (Bay of Monterey, California). This form resembles

C. latifasciatum Piaget (Supplement, p. 130, pl. xiv, fig. 2), from *Rhynchops flavirostris*. The difference in size, number of hairs of the temples, and character of abdominal segments, together with the unrelated host leads us to make the specimen the type of a new species.

Description of female. Body, length 1.84 mm., width .67 mm.; golden brown, with ill-defined, median, transverse abdominal bands, and small dark brown marginal abdominal blotches; head and thorax with blackish markings.

Head, length .35 mm., width .54 mm.; broadly and flatly rounded in front, with numerous, rather long, and a few short, marginal hairs; one very long marginal hair just in front of the ocular emargination, and two shorter hairs directly on the angle; ocular emargination pronounced and acutely angled interiorly; eye prominent, emarginated, with a large ocular fleck; ocular fringe distinct; antennæ with last segment broad, extending beyond the head; temples with anterior angles rounding, posterior angles angularly meeting the occipital margin; three very long and some shorter hairs on the temporal margin; the occiput slightly concave, with four rather long marginal hairs; a narrow, curving, fuscous band running parallel with the clypeal margin, ending at the lateral extremities in a dark chestnut spot; distinct, black, irregular, ocular blotch; triangular bases of occipital bands blackish brown, connected by an even, occipital border, narrowing medially.

Prothorax broad, lateral angles acute, bearing one long hair and a short spine, sides converging posteriorly, with one long hair in the posterior angles; a series of long hairs on the posterior margin. Mesothorax separated from the metathorax by a distinct,

lateral constriction, the posterior margin being distinctly marked with a dark brown band that turns in at the anterior angles along the lateral margins. Metathorax with anterior angles extending beyond the posterior margin of the mesothorax; sides divergent, posterior angles with two long hairs and two short spines; posterior margin straight on the abdomen, with a series of long hairs. Legs robust, concolorous with the metathorax.

Abdomen long, ovate; segments equal, with one or two long hairs and spines in posterior angles, and one or two short spines on lateral margins of each segment; dorsal surface with a single transverse series of hairs along the posterior margin of each segment; the ventral surface with several series of weakly pustulated hairs on each segment; last segment flatly convex, with two dorsal hairs near the lateral margins; ground color pale fuscous, with unevenly colored lateral border of darker fuscous, paling on the outer margins and darkest in posterior angles of segments and along inner margin; a longitudinal, narrow, uncolored, submarginal line parallel with the lateral margin; ill defined, transverse bands slightly darker fuscous.

Colpocephalum funebre Kellogg.

New Mallophaga, I, 1896, p. 147, pl. xii, fig. 7.

One specimen from *Larus heermanni* (Bay of Monterey, California). Described from specimens from *Larus glaucescens* (Bay of Monterey, California).

Colpocephalum pingue Kellogg.

New Mallophaga, I, 1896, p. 144, pl. xii, fig. 5.

One specimen, male, from a Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). Described from the same host species (same locality).

Colpocephalum spinulosum Piaget. (Plate VII, fig. 9).

Les Pediculines, 1880, p. 563, pl. xlvii, fig. 3.

Many specimens from eight out of fifteen individuals examined of the Sanderling, *Calidris arenaria* (Pacific Grove, California). The specimens agree in all essential details of outline and markings with Piaget's description, showing the characteristic, finely pustulated, dorsal surface of the male, with the single transverse series of long pustulated hairs on each segment in the male and the two series in the female. But there is a marked difference in size, the species type being one-fourth larger than our specimens. Piaget's specimens were taken from *Limosa melanura* (Musuem of Leyden). The American specimens should be distinguished by a varietal name.

Var. *minor* Kellogg and Chapman. (Plate VII, fig. 9). In the following table of measurements the figures in brackets are the dimensions given by Piaget for his type specimens. Male. Body, length 1.72 mm. (2.1 mm.), width .5 mm. (.64 mm.); head, length .31 mm. (.38 mm), width .34 mm. (.5 mm). Female. Body, length 2.16 mm. (2.45 mm.), width .7 mm. (.86 mm.); head, length .37 mm. (.38 mm.), width .5 mm. (.5 mm.) From the Sanderling, *Calidris arenaria* (Pacific Grove, California.)

Colpocephalum timidum Kellogg.

New Mallophaga, I, 1896, p. 145, pl. xii, fig. 6.

One specimen from a Black-bellied Plover, *Squatarola squatarola* (Pacific Grove, California). Described from *Charadrius dominicus* (Lawrence, Kansas).

Colpocephalum flavescens Nitzsch. (See Kellogg, New Mallophaga, II, 1896, p. 525, pl. lxxi, fig. 4).

Specimens from the Golden-Eagle, *Aquila chrysaetos* (Palo Alto, California) and from a Siberian Eagle, *Haliaeetus pelagicus* (brought alive from the Arctic Ocean to California). Taken previously by Kellogg from *Haliaeetus leucocephalus* and *Archibuteo lagopus sanctijohannis* (Kansas). Taken by Osborn from "Swallow-tailed Kite" (Ames, Iowa).

Colpocephalum grandiculum n. sp. (Plate VII, fig. 10).

One specimen from a California Towhee, *Pipilo fuscus crissalis* (Palo Alto, California). Also a single specimen, much smaller, (otherwise not indicating immaturity) from a Heerman's Song Sparrow, *Melospiza fasciata heermanni* (Palo Alto, California), which, because of the similarity in outline, characters of legs, and general markings, may be referred to the same species. The species resembles in general shape *C. fumidum* Kellogg (New Mallophaga, II, 1896, p. 523, pl. lxxi, fig. 5) from a California Bush-Tit, *Psaltirparus minimus californicus* (Palo Alto, California).

Description of female. Body, length 2.28 mm., width .81 mm.; head and thorax fulvous, abdomen dull fuscous; small ocular and occipital blotches, very narrow marginal, lateral, abdominal bands; temples produced angularly; a distinct V-shaped uncolored marking between the ocular emarginations, projecting backwards as a more or less distinct uncolored median line through the thorax and abdominal segments 1 to 6.

Head, length .5 mm., width .65 mm.; front broadly rounded, subsemicircular; several hairs on the strictly anterior margin, two rather long hairs on the lateral margin of the front, and two long hairs in front of the ocular emargination; eye distinct, almost if not quite

divided, the larger and anterior portion lying in the angle of the ocular emargination, while the smaller, posterior portion lies apparently on a ridge that extends back across the temples; temples prominent; anterior margin almost at right angles with the median line of the head; ocular fringe prominent, extending as far as the anterior temporal angle, a few short hairs on this angle, two long hairs and a few short spines on the lateral margins and the posterior rounding angles; occipital margin medially convex; head smoky, fulvous, distinct, with slightly darker bands extending towards the lateral margin from the base of the mandibles which are dark brown; a V-shaped uncolored marking, each branch extending from the slight swelling in front of the ocular emargination back two-thirds of the distance to the occipital margin, where the uncolored lines meet at the apex of the V; ocular blotches black, even, angular, extending forward as far as the uncolored branch of the V; temples very narrowly bordered with dark brown on the posterior angles; occipital blotches dark brown to black, sharply defined except on the anterior extremity, where they send out a sharp angular blotch; lateral extremities long and gradually narrowing, inner extremities blunt, separated by a fulvous median space.

Prothorax, lateral angles bluntly rounding, with one long hair and a short spine; lateral margin slightly concave, latero-posterior angles with no hair; posterior margin rounding on the mesothorax; two long hairs on the posterior margin near the lateral posterior angles; evenly fulvous, slightly darker on the lateral margins; chitin transverse and longitudinal bars distinct. Mesothorax with sides diverging, posterior angles slightly protruding, separated distinctly from the metathorax, a long hair on the lateral margin, a dark marginal band

on the anterior angles. Metathorax narrow, sides diverging, posterior angles rounding, posterior margin straight, with one long hair, one short hair, and a short spine; narrow dark brown marginal band on the anterior angle and lateral border; faint indications of an uncolored longitudinal median line. Legs robust; femora broad; fulvous with darker markings on the border; a series of short hairs on the outer margin of the tibia. Sternal markings consisting of intercoxal lines, a distinct shield-shaped median blotch on the prothorax, a narrow median darker longitudinal blotch between the pro- and mesothorax, a larger median blotch between the second and third pair of legs, with a distinct triangular anterior portion and a quadrangular posterior portion.

Abdomen broadly elongate; posterior angles projecting but little, with one long hair in each angle, and a series of dorsal hairs on the posterior margin of each segment; segments widely separated by uncolored sutures; transverse lateral blotches fuscous, darkening on the lateral margins into narrow bands; segments 1 to 5 with the transverse blotches separated by a narrow uncolored median line; segments 5 to 8 entirely dark fuscous; last segment with broadly rounding posterior margin, one long and one short hair each side and a series of short hairs on the posterior margin; color an even fuscous. Ventral surface a small median triangular fuscous blotch on segment 1; transverse blotches uninterrupted, but the posterior margin of the blotches on segments 2 to 6 emarginated, darker fuscous on the posterior margin; a double series of pustulated hairs and a few scattered hairs on each segment.

Ancistrona.

Ancistrona gigas Piaget. (See Kellogg, New Mallophaga, I, 1896, p. 150, pl. xiii, figs. 1 and 2).

A few specimens from the Shearwaters, *Puffinus opisthomelas* and *P. griseus* (from one individual of *opisthomelas* out of thirty-four examined, and from two of *griseus* out of fourteen examined) from the Bay of Monterey, California. Taken previously by Kellogg from *Fulmarus glacialis* vars. *rodgersii* and *glupischa* (Bay of Monterey, California).

Trinoton.

Trinoton luridum Nitzsch. (See Kellogg, New Mallophaga, I, 1896, p. 152, pl. xiii, fig. 4).

Specimens from the Baldpate, *Anas americana*, and the American Scaup Duck, *Aythya marila nearctica*, (Palo Alto, California) and from the Shoveller, *Spatula clypeata* (Mountain View, California). Taken previously by Kellogg from two of these hosts, and from other duck species (Kansas and California).

Trinoton lituratum Nitzsch. (See Kellogg, New Mallophaga, I, 1896, p. 151, pl. xiii, fig. 3).

Specimens from the Shoveller, *Spatula clypeata* (Mountain View, California) and from another individual of the same species (Palo Alto, California). Taken previously by Kellogg from *Dafila acuta* and *Merganser americanus* (Lawrence, Kansas).

Menopon.

Menopon tridens Nitzsch. (See Kellogg, New Mallophaga, I, 1896, p. 165, pl. xv, figs. 3 and 4).

Specimens from an American Eared Grebe, *Colymbus nigricollis californicus* (Bay of Monterey, California); from the Western Grebe, *Aechmophorus occidentalis* (one bird from Washington, and one from California); and from the Californian Clapper Rail, *Rallus obsoletus* (three birds), and the Virginia Rail, *Rallus virginianus* (Palo Alto, California). Taken previously by Kellogg from the two hosts first named, and from *Urinator lumme* (California).

Menopon infrequens Kellogg.

New Mallophaga, I, 1896, p. 161, pl. xv, fig. 5.

Ten specimens from *Larus delewarensis* (Bay of Monterey, California). Described from a single female from *Larus glaucescens* (Bay of Monterey, California). The male is much smaller than the female, as shown by following measurements: body, length 1.4 mm., width .6 mm.; head, length .25 mm., width .53 mm.

Menopon irrumpens n. sp. (Plate VIII, fig. 1).

Four specimens from a Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). No *Menopon* has been hitherto taken from an Albatross.

Description of female. Body, length 2.23 mm.; width 1.01 mm.; short, broad; dark chestnut-brown with darker blotches on the head and lateral bands on thorax and abdomen.

Head, length .4 mm., width .74 mm.; wide through the temples; elypeus broad, with a slightly angulated front; one rather long and one shorter marginal hair each side of the angular point of the elypeus, a short prickle near the suture; three long marginal hairs on the slight swelling in front of the ocular emargination, two short hairs in front of these, nearer the suture;

ocular fringe distinct, composed of stiff curving hairs which extend slightly on the temporal margin; temples with posterior angles produced; four long pustulated hairs, two shorter hairs, and one short spine on the margin; occipital margin concave, with a series of six long pustulated hairs and one spine; color of the head light chestnut-brown, with dark brown ocular blotches and black ocular fleck, and dark chestnut markings in front, near the mandibles, which show through the head distinctly; occipital margin with a narrow chestnut band, darkening into broad occipital blotches.

Prothorax broad, sides rapidly converging posteriorly; lateral angles narrowly rounding, with a short spine and a long pustulated hair in the angle, a series of fourteen strong hairs along the convex posterior margin; general color dark chestnut-brown, except the space above the conspicuous dark transverse chitin bar, which is pale fuscous; the longitudinal bars, at the ends of the transverse bar, are narrow but distinct. Metathorax short, hardly broader than the prothorax; sides divergent, with two spines on the lateral margins; two long hairs and two short spines on the posterior angles; a series of long pustulated hairs on the posterior margin not so heavy, however, as those of the prothorax; color chiefly dark chestnut-brown, transverse band darkening into a narrow black line along the lateral margin, and into a broad triangle in the posterior angles; in front of this dark band, a pale, broad, mesosutural band, and in front of this the pale brown mesothorax. Legs of the palest fuscous of the prothorax, with several short, stiff hairs on the femora and tibia.

Abdomen broadly elliptical, with several short spines on the lateral margins of the segments, and from one to five long hairs in the posterior angles; a series of

long hairs on the posterior margin of each segment; transverse blotches of dark chestnut-brown continuous across the segments, with but a very narrow, pale, posterior marginal line; the lateral marginal bands are wide and distinctly darker brown, and they do not reach the posterior margins; the last segment broadly emarginate, with two long, dorsal hairs on the rounded, posterior angles, and two very short spines on the inner margin of the emargination; the ventral surface with dark transverse bands and a series of hairs along the posterior margin of each segment.

Menopon paululum n. sp. (Plate VIII, fig. 2).

Specimens from three out of thirty-four individuals shot of the Black-bodied Shearwater, *Puffinus opisthomelas*, from two out of fourteen shot of *Puffinus griseus*, and from two specimens out of six shot of *Puffinus creatopus*. The first *Menopon* species recorded from *Puffinus*. The new species shows no special resemblance to forms taken from allied birds, like Fulmars.

Description of the male. Body, length 1.13 mm., width .5 mm.; small, pale yellow with distinct brown ocular blotches; abdomen with golden transverse bands and brown marginal blotches.

Head, length .26 mm., width .38 mm.; front rounding, with four short hairs on the margin, one marginal hair at the suture, three long and one short hair in front of the ocular emargination which is distinct but shallow, with an ocular fringe; maxillary palpi long, last two segments extending beyond the margin of the head; eyes inconspicuous but with a distinct ocular fleck; temples but little expanded, with four long hairs and several short spines on the angles; occipital margin but slightly concave; head pale yellow with a brown

spot just outside the mandibles connected with them by a narrow brown band; mandibles dark, showing through the head; ocular blotches small, narrowing posteriorly; occipital margin with a narrow brown band and small occipital blotches.

Prothorax with anterior angles slightly produced, a short prickle and a long hair in the angle, a series of long hairs on the rounding posterior margin; transverse and longitudinal chitin bars pale yet distinct; no blotches. Metathorax with slight lateral emargination; posterior margin nearly straight, with a series of spiny hairs; a pale golden, narrow, mesothoracic, transverse band, and similarly colored, wider, metathoracic bands. Legs pale golden; femora thick. A median prosternal blotch, shield-shaped, with a lateral process projecting backward and outward; metasternum with a pale median blotch from which short spiny hairs arise.

Abdomen elliptical, with posterior angles of the segments slightly produced, a few short spines on the lateral margins, and one or two long hairs and short spines in the posterior angles; a series of stiff hairs along the posterior margin of the segments, those on the last segments being longer; on the ventral surface two transverse series of short spiny hairs on each segment; pale golden transverse bands extending across the segments to shiny brown subcircular marginal blotches; last segment rounding behind, without marginal blotches, and with a few longish hairs.

Female. Body, length 1.74 mm., width .67 mm.; head, length .27 mm., width .45 mm., thus being much longer than the male; transverse bands of the abdomen rather more distinct than in the male, the uncolored sutural bands being thus made also more distinct, each segment with posterior series of hairs; last segment

with six stiff hairs on each rounding angular portion of the posterior margin, and the median straight portion with an uncolored border and fringe of fine hairs.

Menopon petulans n. sp. (Plate VIII, fig. 3).

One specimen from a Black-bodied Shearwater, *Puffinus griseus* (Bay of Monterey, California). Shorter, broader, and darker colored than *paululum* n. sp. from *Puffinus opisthomelas* (same locality).

Description of male. Body, length 1.34 mm., width .68 mm.; short, broadly elliptical; head with distinct ocular emargination and projecting temples; general color dark fuscous with distinct, large black ocular blotches; transverse abdominal bands fading in their medial portions but distinct laterally.

Head, length .28 mm., width .53 mm.; front rounded, with a very slight median angulation; a rather long median hair each side of the front angulation; a short marginal prickle in front of the suture, one rather long marginal hair just back of the suture; two pustulated hairs and one long spine in front of a distinct ocular emargination; eye distinct, filling base of ocular emargination with a black ocular fleck; temples rounding, projecting, with three long hairs and several spines; occipital margin concave, with six long hairs and two spines on the margin; front of the head with slightly darker brown triangular blotches each side of the pale front; mandibles showing through the head as a dark brown spot; ocular blotch broad and distinctly black, fading gradually along the temporal margin; occipital bands faintly showing; occipital blotches distinct, being connected by a narrow black band which fades on the temporal margins.

Prothorax with lateral angles narrowly rounding, with one long hair and a short spine, a series of long hairs on the rounding posterior margin; lateral blotches but little darker on the margins; transverse chitin bar distinct, but little darker than the fuscous ground color of the prothorax. Metathorax short, lateral margins slightly divergent, a little concave, a short prickle near the posterior angles and a long hair and one short spine in the angle; a series of hairs along the weakly convex posterior margin; lateral blotches distinct, meeting on the median line; darker brown to black on the lateral margins, a pale band on the posterior margin. Legs robust, pale fuscous with darker marginal markings. Sternal markings consisting of a distinct median blotch, with rounded anterior margins, posterior angles projecting backward, posterior margin also produced into a distinct angle.

Abdomen broadly elliptical, segments with short spines on the lateral margins and a few long hairs in the posterior angles; a series of dorsal, spiny hairs on the posterior margin of each segment; general color of the abdomen dark fuscous; lateral blotches distinct, black on the lateral margins, paler and fading out medially on the segments before segment 7; segments 7 and 8 with continuous transverse bands; segment 9 wide, with two lateral blotches meeting narrowly on the median line and a paler band on the lateral margin; the last segment flatly rounding; two short hairs on the posterior margin; ventral markings very similar to those of the dorsal surface, also a similar series of hairs on the posterior margins of the segments.

Menopon titan Piaget. (See Kellogg, New Mallophaga, I, 1896, p. 163, pl. xv, fig. 2).

One male from a Brandt's Cormorant, *Phalacrocorax penicillatus* (Bay of Monterey, California). This specimen differs from every other individual of this curious species that I have yet examined. It is smaller than var. *linearis*, the blotches of thorax are different, and the incomplete series of pustulated hairs along the posterior margins of the abdominal cross-bands conspicuously differ from the usual condition in *titan*. *Titan* has not before been taken from any other bird than a pelican, and this single individual from a cormorant may be a straggler. If so, it must have come from *Pelecanus californicus*, the only species of pelican found in the Bay of Monterey.

Var. *incompositum* Kellogg and Chapman. (Plate VIII, figs. 4 and 5). Male, body, length 4.6 mm., width 1.66 mm.; head, length .62 mm., width 1. mm.; the smallest variety of *titan* yet noted; mesothorax with a narrow transverse blackish band continuous across the segment; metathorax with triangular, blackish, lateral blotches, apex projecting inward; abdominal segments 1-8 with continuous, blackish, transversal bands, paler on segments 7 and 8; an incomplete series of pustules (six complete and prominent on segments 3-6) along posterior margin of each transverse band; last segment with a small transversal linear blotch on each side; genital blotch on underside of segment 8 composed of two lateral triangles partly overlapping a central shield, from which projects anteriorly a sharp, distinct, linear process; laterad of this central compound blotch there is on each side a weakly curving, blackish, diagonal, linear blotch. Found on Brandt's Cormorant, *Phalacrocorax penicillatus* (Bay of Monterey, California).

Menopon titan var. **linearis** Kellogg.

New Mallophaga, I, 1896, p. 163, pl. xv, fig. 2.

Many specimens from the Californian Brown Pelican, *Pelecanus californicus* (Bay of Monterey, California). Described from the same host species, same locality.

Menopon funereum n. sp. (Plate VIII, fig. 6).

A single male from a Gairdner's Woodpecker, *Dryobates pubescens gairdnerii* (Sunol, California), and a pale male from a Western Evening Grosbeak, *Coccothraustes vespertinus montanus* (California). This second specimen determined with doubt. Not like *M. pici* Denny (Monograph. Anoplur. Brit., p. 219, pl. xx, fig. 5; Piaget, Supplement, p. 93, pl. x, fig. 3) from *Picus viridis*; also differing distinctly from *M. præcursor* Kellogg (Mallophaga from Birds of Panama, Baja California, and Alaska, in New Mallophaga, III, 1899, p. 46, pl. iv, fig. 8) from *Melanerpes uropygialis* (Baja California).

Description of the male. Body, length 1.5 mm., width .59 mm.; mostly dark colored because of the strong, continuous, brown, transverse, abdominal bands and the blackish marking of the head, thorax and legs; thorax long, with mesothoracic sutural line distinct under magnification.

Head, length .4 mm., width .56 mm.; front convex, with two marginal hairs near the median line of the front, a short prickle midway between this hair and a long hair and short spine which are on the angle in front of a slight lateral concavity, in which are a long hair and short prickle; a long hair and shorter hair near the posterior angle of the concavity and in front of the angle before the ocular emargination on which are two long hairs; eye large, filling the inner angle of the ocular emargination, distinctly emarginate and

with a large black ocular fleck; a rather long hair on its dorsal surface near the margin; a distinct ocular fringe; temple meeting the ocular emargination angularly; fine, long, pustulated hairs and some short spines on the temporal margin; occipital margin concave, with two long hairs near the median line; ground color of the head pale fuscous with dark blackish brown blotches each side of the front; ocular blotches broad, distinct on the posterior margin but fading anteriorly till they color the angle in front of the ocular emargination; temples narrowly and irregularly bordered with dark brown; occipital margin with a defined blackish brown band, widening into angular occipital blotches; distinct occipital signature.

Prothorax short; anterior angles inconspicuous, with two spines; posterior margin with a series of long hairs; ground color dark fuscous, with distinct chitin bars. Mesothorax and metathorax long, being separated by a narrow, uncolored suture and slight lateral emargination, mesothorax dark on the anterior portion; metathorax with distinct dark chitin bars. Sternal markings consisting of dark intercoxal lines; prothorax with distinct median blotch of pale fuscous, a distinct V-shaped chitin bar longitudinally across it; dark median blotches on the meso- and metathorax. Legs large, pale fuscous with dark marginal borders and semiannulations; scattered hairs and spines.

Abdomen short, broadly elliptical, small as compared with the large head and thorax, which are together longer than the abdomen; a series of long hairs on the posterior margin of each segment and a few short spines and hairs in the posterior angles; each segment with a broad, dark, transverse band, darker on the lateral margin and covering almost all of the segment; a

longitudinal, submarginal, pale band, parallel with the lateral margins of the abdomen; last segment broadly rounded, with several long hairs near the lateral margin and some shorter hairs on the posterior portion of the segment; ventral surface with at least one series of short pustulated hairs on the posterior margin of each segment; genitalia distinct, angular, extending far forward in the body.

Menopon distinctum n. sp. (Plate VIII, fig. 7).

Specimens from two specimens of the Ash-throated Flycatcher, *Myiarchus cinerascens* (Palo Alto and Ontario, California), and from a Cactus Wren, *Heleodytes brunneicapillus* (Ontario, California). A well marked form.

Description of the female. Body, length 1.5 mm. width .62 mm., elongate-elliptical; pale translucent fuscous with blackish brown ocular blotches; black ocular fleck and small blackish spots on the lateral margins of the front; dark transverse blotches on the abdomen; a distinct pale submarginal longitudinal line parallel with the lateral margin of the abdomen.

Head, length .31 mm., width .46 mm.; parabolic, wide through the temples; front broadly rounding, a slight angulation in front; one hair each side of this angulation; two hairs on the lateral margin of the front; two long hairs on a slight swelling in front of a distinct ocular emargination; one long and two short hairs on the dorsal surface, in front of the ocular emargination; eye large, filling the angle of the emargination and extending on the temple, with a slight constriction; a short spine on the posterior portion, and a large black ocular fleck; ocular fringe made up of comparatively few stiff spines, more numerous on the outer

margin in front of the temples; two long hairs and several shorter hairs on the temporal margin; occipital margin nearly straight, with two long and two short hairs; pale translucent fuscous; mandibles dark, showing through the front; a dark spot on the lateral margin of the front outside the base of the mandibles; ocular blotches dark brown to black, extending forward as far as the dark lateral blotches, but paler chestnut-brown anteriorly; dark narrow border on the occiput, occipital bands pale yet distinct.

Prothorax with convex lateral margins; a short spine in the anterior angle; a few spines on the lateral margin; a series of long hairs on the rounding posterior margin; fulvous, with dark transverse and longitudinal chitin bars distinct. Mesothorax wide, with strongly divergent sides; a few spines on the lateral margin; one long hair and several spines in the posterior angle; dark inner chitin bars extending along the anterior angle and back across the segment; a second chitin bar extending from the lateral margin back across the metathorax; the posterior angle of the mesothorax dark fuscous, otherwise the segment is pale translucent fuscous. Metathorax narrow; a long hair and a short spine in the posterior angles; dark lateral triangular blotches, fading inwardly. Legs long, pale translucent fuscous, with dark fuscous borders and semiannulations; many short spines on the femora. Sternal markings consisting of distinct brown intercoxal lines and a pale but distinct wedge-shaped median blotch.

Abdomen broadly elliptical; several spines on the lateral margins of the segments; some long hairs in the posterior angles; many dorsal spines, not arranged in any definite series on the segments; lateral marginal blotches dark fuscous, separated from the median

transverse blotches by a pale submarginal band, parallel with the lateral margin of the abdomen; median transverse blotches paler fuscous; transverse bands of segments 1 to 6 widely separated by uncolored sutural bands; last segment rounding, with a fringe of hairs on the posterior margin, dark transverse blotch narrowed distinctly in the middle, ventral transverse bands distinctly fuscous; many hairs arranged nearly in two definite series in each segment.

Male. Body, length 1. mm., width .59 mm.; head, length .25 mm., width .5 mm.

Menopon persignatum n. sp. (Plate IX, fig. 1).

Many specimens from the California Jay, *Aphelocoma californica* (2 specimens, Mountain View, California). Resembling in general shape and characters the three or four species of *Menopon* described by Nitzsch and Piaget from the European Jays.

Description of the female. Body, length 2.03 mm., width .75 mm.; long, narrow; pale fuscous with distinct black ocular blotches, blackish lines in the thorax, and broad dark fuscous transverse abdominal bands.

Head, length .34 mm., width .56 mm.,; front broadly but slightly angularly rounding; no hairs on the frontal margin, one long and two shorter hairs on the lateral margins of forehead, besides two long hairs just in front of the ocular emargination, which is nearly filled by the large eye which is slightly emarginated and bears a short prickle; ocular fringe with only a few hairs of uneven length; temples produced, rather narrowly rounded, with five long hairs and several short hairs and spines on the margin; occipital margin straight in its middle portion; one long and one short hair near

the posterior margin, and one hair on each side of the median line; ground color of the head fuscous with distinct, curving, linear blackish ocular blotches; an indistinct brown occipital signature with anterior angles produced laterally.

Prothorax large, lateral angles with one long hair and a short spine, two long hairs in the broadly rounded posterior angle and a series of six long hairs on the straight posterior margin. Mesothorax with four or five short spines on the lateral margin and two long hairs and two spines in the posterior angle; a series of stiff hairs along the posterior margin. Metathorax with a series of stiff hairs on its posterior margin, and in the posterior angle one long hair and two spines; ground color of the thorax is pale fuscous, no distinct blotches, but dark transverse and longitudinal chitin bars on the prothorax; curving chitin bars on the anterior angle of the mesothorax, and a pair of chitin bars extending from the anterior half of the lateral margin of the mesothorax back across the metathorax as far as the third pair of coxæ. Sternal markings consisting of dark intercoxal lines; on the prothorax a small median blotch with the posterior angles extended in dark chitin bars which extend forward to the anterior margin; the posterior margin of the blotch extends back in a narrow point; a large wedge-shaped blotch between the second and third pair of coxæ; this blotch has a series of short pustulated hairs on its anterior and lateral margins. Legs pale fuscous with narrow dark borders.

Abdomen elongate-elliptical; two long hairs and short spines in the posterior angles; a series of short hairs on the posterior margin of each segment, growing more stiff and spine-like near the lateral margin; broad dark

fuscous transverse bands separated by broad pale sutural bands; darkening laterally to form broad dark lateral bands, set off by rather broad pale submarginal, longitudinal bands; last segment flatly rounding, with a fringe of fine hairs; ventral surface with similar markings, but with an irregular median transverse series of hairs, besides the series on the posterior margin of the segment.

Male. Body, length 1.43 mm., width .75 mm.; head, length .28 mm., width .56 mm., thus being much smaller than the female; also of short, broad, oval shape rather than elongate and narrow; darker and more evenly fuscous; pale submarginal longitudinal bands parallel with the sides of the abdomen less distinct than in female; transverse bands narrow and less definite; lateral blotches narrow and darker on the posterior margin of the segments; last segment slightly angular, with a fringe of hairs; genitalia faintly distinguishable through the body, extending forward into segment 7.

Menopon incertum Kellogg.

New Mallophaga, II, 1896, p. 533, pl. lxxiii, fig. 2.

Many specimens from a Russet-backed Thrush, *Turdus ustulatus* (Palo Alto, California); a Western Lark Sparrow, *Chondestes grammacus strigatus* (Ontario, California); and a Vigor's Wren, *Thryothorus bewickii spilurus* (Palo Alto, California). Taken previously by Kellogg from *Turdus ustulatus* and from the American Goldfinch, *Spinus tristis* (same locality).

Menopon mæstum n. sp. (Plate IX, fig. 2).

Two specimens from a Golden-crowned Sparrow, *Zonotrichia coronata* (Palo Alto, California), and a

Samuel's Song Sparrow, *Melospiza fasciata samuelis* (Palo Alto, California): A short, broad species, with short, wide head, and wide prothorax, approaching the *Eureum* type of *Menopon* (see p. 133 this paper).

Description. Body, length 1.37 mm.; width .81 mm.; short, broad; head very short and wide, not of the usual evenly crescentic type; occipital margin straight and dark; general color dark fuscous, the dark markings of the head making the posterior portion appear quadrangular.

Head, length .28 mm., width .59 mm.; front broad, flatly rounded; six hairs on the front, one each side of the angulation and three (one long and two shorter) hairs on the lateral margins of the front; two hairs on the angle in front of the ocular emargination; lateral margin of the forehead almost at right angles with the lateral margins of the front; eye large, prominent, with a large black ocular fleck and a short spine; ocular fringe sparsely spined; temples projecting strongly, and narrowly convex, with three long hairs and several shorter hairs and spines; occipital margin straight; a narrow broad submarginal band across the front, its posterior ends bending in so as to leave clear pale brown the anterior portion of the angle in front of the ocular emargination; from this angle a distinct dark fuscous quadrangular blotch extends back to the occipital margin, cutting off the rounding temples which are very pale fuscous; ocular blotches narrow and dark, extending forward along the ocular emargination, meeting the anterior margin of the dark fuscous blotch interrupting the arms of the narrow uncolored V-shaped marking, which has its branches rising from the inner angle of the ocular emargination and its vertex on the occipital margin; occipital blotches blackish

brown, connected by a narrow even line on the occipital margin; a dark broad occipital signature showing through the head.

Prothorax short and wide; two short spines in the anterior margin and a series of four long pustulated hairs and one short spine on each rounding lateral and posterior margin; transverse and longitudinal chitin bars distinct; median portion of the prothorax pale anteriorly, but darker fuscous towards the posterior margin; lateral portions, beyond the longitudinal chitin bars, dark fuscous. Mesothorax narrow; posterior angles distinctly angular, with a long hair and spine; dark transverse band on the posterior margin, dark longitudinal chitin bars extending from the anterior angles across the mesothorax; a second pair of chitin bars extending from the anterior, lateral margins back across the metathorax. Metathorax narrow, appearing like the first abdominal segment; a long hair and two spines in the posterior angle; a dark brown transverse band across the lateral margin. Sternal markings consisting of dark intercoxal lines, a median blotch on the prothorax, with the posterior angles produced laterally, meeting narrow dark chitin bars which extend forward to the anterior margin; the posterior margin of the blotch also produced in an angle; a broad brown median band between the second and third pair of legs, also extending onto the first abdominal segments; a few scattered pustulated hairs on this band. Legs large, pale fuscous, with narrow dark borders and scattered hairs.

Abdomen broadly ovate, the poles broadly truncate; posterior angles projecting, with one or two long hairs and a short spine; segments narrower on the anterior half of the abdomen; a few hairs on the posterior margin of the segments; entire abdomen a dark rich

fuscous, darker on the posterior margins of the segments; last segment broad, narrow, with a fringe of hairs along the rounding posterior margin.

Menopon malleus Nitzsch (Plate IX, fig. 3).

Germer's Mag. Ent., 1818, vol. iii, p. 301.

Eureum malleus Nitzsch, Burmeister, Handb. d. Ent., 1840, vol. ii, p. 441; Denny, Monograph. Anoplur. Brit., 1842, p. 288; Giebel, Insecta Epizoa, 1874, p. 249; Piaget, Les Pediculines, 1880, p. 608, Supplement, 1885, p. 139, pl. xv, fig. 3.

A single immature specimen from a Cliff Swallow, *Petrochelidon lunifrons* (Ontario, California), and an adult female and an immature specimen from a Cactus Wren, *Heleodytes brunneicapillus* (Ontario, California). The single specimen of this species previously known was collected by Nitzsch in 1814 from *Hirundo rustica*. As the above named Cliff Swallow and Cactus Wren were collected by the same person on the same day it may be that the two individuals taken from the wren are stragglers from the swallow.

This species has heretofore been attributed to the genus *Eureum* Nitzsch, the genus being based upon the single specimen (which, though heretofore apparently not so considered, is immature) of this species and a very few specimens of another very different species, *cimicoides* Nitzsch from the European Swift *Cypselus apus*. Piaget has suspected that both these species are merely rather aberrant members of the genus *Menopon*, which position, as regards the species *malleus*, at least, we take unqualifiedly. The two species have been held together partly through the usual conception of the near relationship of the hosts; as Nitzsch says, "*habitatio in chelidonum familia*" (Germer's Mag. Ent., vol. iii, p. 301, 1818). Now, in fact, the swallows and the swifts are not nearly related at all, the swifts finding

their near relations among the night-hawks and hummingbirds. The finding of an immature and an adult female together on the wren, in addition to a single immature specimen on the swallow, allows us to present new evidence of the agreement of the species in generic characters with *Menopon*. The *Menopon* species, *maestum*, described in this paper, serves as an easy step from the more typical *Menopon* type to this peculiar *Eureum* type with its short, broad head, its short, broad prothorax, and long, heavy legs. *Menopon robustum* Kellogg (New Mallophaga, II, 1896, p. 528, pl. lxxii, fig. 3) is of this gradatory type, and presents "a mingling of characters of *Menopon*, *Ancistrona*, and *Eureum*; a short, broad head with strongly chitinized, backward-projecting processes on the ventral surface like *Ancistrona*; a thorax like *Eureum*; and the habitus and general body characters of *Menopon*" (Kellogg, l. c.). Osborn's *M. expansum* (Insects Affecting Domestic Animals, U. S. Dept. Ag., Div. Ent., Bull. N. S., No. 5, 1896, p. 245, pl. ii, fig. j.) from *Dolichonyx oryzivorus* must also be of this general type.

Our immature forms correspond with the description and figure (Piaget, Supplement, p. 139, pl. xv, fig. 3) of the species. Our adult female (figured herewith) shows the following characters not referred to, or unconformable to those in Piaget's description. Body, length 2.25 mm., width 1.15 mm.; head, length .34 mm., width .9 mm.; head less flatly rounded in front than in the young, and with a slight median angulation; on each side of this angulation a conspicuous marginal hair, and farther to the side a longer hair not marginal, but rising from just in front of the base of the antenna. Metathorax with two long hairs and three spines in the posterior angles, the three spines ranged along the

posterior margin. Dorsal surface of the abdomen with a few scattered, longish hairs; ventral surface with groups of short, strong spines and some longish hairs on the lateral part of the posterior margins of segments; last segment broadly rounded behind, with fringe of weak hairs of different lengths.

Menopon ridulosum n. sp. (Plate IX, fig. 4).

Specimens from two Yellow Warblers, *Dendroica aestiva* (Palo Alto, California). A small, heavy-bodied form.

Description. Body, length 1. mm., width .53 mm.; being thus a very small species; head large compared with the rest of the body; head almost as wide as long; abdomen with narrow transverse abdominal bands.

Head, length .46 mm., width .51 mm.; large, nearly as broad as the abdomen; front broadly parabolic, with a slight median angulation; two short hairs in front each side of the angle, several shorter hairs in the frontal margin, two longer hairs on the lateral margin, and two long hairs on the angle before the shallow ocular emargination; eye with a black ocular fleck; ocular fringe distinct; two very long hairs on the narrowly rounding temples and several short spines; occipital margin concave, with four long hairs on the margin; two small angular blackish spots on the lateral margin of the front outside the mandibles, which are also dark, showing through the head; ocular blotches curving, blackish brown, fading on the anterior portion of the ocular emargination; a narrow band of dark blackish brown on the occipital margin.

Prothorax wide; a long hair and short spine on the anterior angle; a series of long hairs on the rounding posterior margin; dark transverse and longitudinal

chitin bars distinct, dark brown, while the ground color of the prothorax is even pale fulvous. Mesothorax long, with strongly diverging sides; posterior angles sharp, with several long hairs and broad heavy spines; a series of hairs on the posterior margin; ground color pale fulvous with distinct, narrow chitin bars extending from the anterior angles across the mesothorax, a second pair of chitin bars extending from the lateral margins across the meso- and metathorax. Metathorax narrow; posterior angles with a few long hairs and heavy spines; posterior margin with a series of hairs; intercoxal lines showing through the thorax. Legs pale fulvous with darker marginal markings.

Abdomen broadly elliptical, short; posterior angles with one or two long hairs and some heavy spines; a series of hairs on the posterior margin of the segments, which give place to heavy spines near the lateral margin; a few scattered dorsal spines; last segment flatly rounded, with a few short marginal spines; narrow dark fuscous transverse bands, separated by broad pale transverse bands.

Physostomum.

We have representatives of this genus from a dozen species of passerine birds, but we do not feel able to make satisfactory specific determination of our material except in a few instances. We do not believe that under the present knowledge of the group much can be done toward distinguishing any but peculiar and obviously characterized species, forms readily separable by marked peculiarity of shape. We have specimens of this genus from the following birds, all from California: Western Wood Pewee, *Contopus richardsonii* (two specimens); Say's Phoebe, *Sayornis saya*; Western

Flycatcher, *Empidonax difficilis*; Ash-throated Flycatcher, *Myiarchus cinerascens*; Spurred Towhee, *Pipilo maculatus megalonyx*; California Towhee, *Pipilo fuscus crissalis*; Cedar Waxwing, *Ampelis cedrorum*; Samuel's Song Sparrow, *Melospiza fasciata samuelis*; Least Vireo, *Vireo bellii pusillus*. In addition, we distinguish the three following species of the genus.

Physostomum sucinaceum Kellogg.

New Mallophaga, II, 1896, p. 514, pl. lxx, fig. 2.

Three specimens from a Western Flycatcher, *Empidonax difficilis* (Palo Alto, California). Previously taken by Kellogg from the same host (same locality).

Physostomum diffusum Kellogg.

New Mallophaga, II, 1896, p. 518, pl. lxx, fig. 3.

One specimen, var. *pallidum* Kellogg from an Oregon Junco, *Junco hyemalis oregonus* (Pullman, Washington). Taken previously by Kellogg from *Junco* sp. (Lawrence, Kansas).

Physostomum prominens n. sp. (Plate IX, fig. 5).

Two specimens from a Costa's Hummingbird, *Calypte costae* (Ontario, California). This strange form with its lateral head margins deeply sinuate and its unique prothorax is very different from any other *Physostomum* described. The specimens are probably not fully mature, one distinctly immature, the other lacking probably only coloration intensity.

Description. Body, length 2 mm., width .85 mm.; transparent whitish; head short and broad, with deeply sinuous lateral margins; eyes in the posterior angles.

Head, length .5 mm., width .53 mm.; broad, short; front broad, straight; conspicuous projecting lateral

palettes; the lateral margins of the head deeply concave before the middle; temples swollen, the margins convex; head widest across the posterior angles which are not produced backwards, but rounding rectangular; the inconspicuous eyes with conspicuous black flecks are situated in the very apex of these angles; each angle bears two longish hairs and one shorter one; posterior margin nearly straight, feebly angulated in the middle; whole head transparent whitish with faint brownish tinge here and there.

Prothorax large, lateral margins with lateral angles broadly and bluntly rounded; posterior margin almost semicircular, with four rather short hairs on each lateral half; pale transparent whitish with faint brownish at margins. Metathorax with rapidly diverging lateral margins, straight posterior margin with two hairs and a spine in region of posterior angles, three hairs near posterior margin just inside of this region, and two hairs and a spine anterior to these submarginal hairs.

Abdomen broadly elliptical; posterior angles not projecting and without conspicuous hairs; on the lateral portion of each segment a group of three hairs near the posterior margin, and a hair and a spine near the lateral margin and more anterior; pale transparent whitish with a pale brown narrow submarginal longitudinal band fading posteriorly.

LIST OF HOSTS WITH PARASITES.

<i>Æchmophorus occidentalis.</i>	<i>Larus heermanni.</i>
<i>Menopon tridens.</i>	<i>Docophorus lari.</i>
<i>Colymbus nigricollis californicus.</i>	<i>Colpocephalum funebre.</i>
<i>Nirmus fusco-marginatus</i> var.	<i>Sterna maxima.</i>
<i>americanus.</i>	<i>Docophorus melanocephalus.</i>
<i>Menopon tridens.</i>	<i>Diomedea albatrus.</i>
<i>Lunda cirrhata.</i>	<i>Nirmus giganticola.</i>
<i>Nirmus pacificus.</i>	<i>Lipeurus diversus.</i>
<i>Colpocephalum perplanum.</i>	<i>densus.</i>
<i>Cerorhinca monocerata.</i>	<i>concinus.</i>
<i>Nirmus maritimus.</i>	<i>ferox.</i>
<i>Ptychoramphus aleuticus.</i>	<i>Giebelia mirabilis.</i>
<i>Nirmus maritimus.</i>	<i>Eurymetopus taurus.</i>
<i>Synthliboramphus antiquus.</i>	<i>Colpocephalum pingue.</i>
<i>Nirmus maritimus.</i>	<i>Menopon irrumpens.</i>
<i>Cephus columba.</i>	<i>Fulmarus glacialis glupischa</i>
<i>Docophorus procax.</i>	<i>Nirmus maritimus.</i>
<i>Nirmus pacificus.</i>	<i>Puffinus creatopus.</i>
<i>fusco-marginatus</i> var.	<i>Lipeurus diversus.</i>
<i>americanus.</i>	<i>testaceus.</i>
<i>Stercorarius pomarinus.</i>	<i>fuliginosus</i> var. <i>ma-</i>
<i>Docophorus melanocephalus.</i>	<i>jor.</i>
<i>Nirmus triangulatus.</i>	<i>laculatus.</i>
<i>Lipeurus laculatus.</i>	<i>Giebelia mirabilis.</i>
<i>Rissa tridactyla pollicaris.</i>	<i>Menopon paululum.</i>
<i>Nirmus lineolatus</i> var. <i>atri-</i>	<i>Puffinus opisthomelas.</i>
<i>marginatus.</i>	<i>Docophorus validus.</i>
<i>Larus occidentalis.</i>	<i>Lipeurus diversus</i>
<i>Docophorus lari.</i>	<i>testaceus.</i>
<i>Larus argentatus smithsonianus.</i>	<i>limitatus.</i>
<i>Nirmus fusco-marginatus</i> var.	<i>fuliginosus</i> var. <i>ma-</i>
<i>americanus.</i>	<i>jor.</i>
<i>Larus vegæ.</i>	<i>Ancistrona gigas.</i>
<i>Nirmus lineolatus</i> var. <i>atri-</i>	<i>Giebelia mirabilis.</i>
<i>marginatus.</i>	<i>Menopon paululum.</i>
<i>Larus delewarensis.</i>	
<i>Docophorus lari.</i>	<i>Puffinus griseus.</i>
<i>Nirmus punctatus.</i>	<i>Nirmus giganticola.</i>
<i>Menopon infrequens.</i>	<i>pacificus.</i>
<i>Larus brachyrhynchus.</i>	<i>Lipeurus diversus.</i>
<i>Nirmus lineolatus</i> var. <i>atri-</i>	<i>limitatus.</i>
<i>marginatus.</i>	<i>Giebelia mirabilis.</i>
<i>Larus canus.</i>	<i>Ancistrona gigas.</i>
<i>Nirmus lineolatus</i> var. <i>atri-</i>	<i>Menopon paululum.</i>
<i>marginatus.</i>	<i>petulans.</i>

- Puffinus tenuirostris.*
 Lipeurus diversus.
 limitatus.
 Giebelia mirabilis.
Puffinus bulleri.
 Lipeurus diversus.
 limitatus.
 Giebelia mirabilis
Phalacrocorax penicillatus.
 Lipeurus farallonii.
 Menopon titan var. *incompositum.*
Pelecanus californicus.
 Lipeurus forficulatus.
 Menopon titan var. *linearis.*
Anas americana.
 Trinoton luridum.
Spatula clypeata.
 Lipeurus squalidus.
 Trinoton lituratum.
 luridum.

Aythya marila nearctica.
 Docophorus icterodes.
 Trinoton luridum.
Aythya affinis.
 Docophorus icterodes.
Rallus obsoletus.
 Oncophorus bisetosus var. *californicus.*
 Menopon tridens.
Rallus virginianus.
 Oncophorus bisetosus var. *californicus.*
 Menopon tridens.
Tringa minutilla.
 Docophorus fusiformis.
 Nirmus complexivus.
Calidris arenaria.
 Nirmus actophilus.
 complexivus.
 Colpocephalum spinulosum var. *minor.*
Limosa fedoa.
 Nirmus cordatus.
- Squatarola squatarola.*
 Docophorus fuliginosus.
 Nirmus incœnis.
 Colpocephalum timidum.
Ægialitis semipalmata.
 Docophorus fuliginosus.
 Nirmus opacus.
Oreortyx pictus plumiferus.
 Lipeurus docophoroides var. *californicus.*
Dendragapus obscurus fuliginosus.
 Lipeurus perplexus.
Pediocætes phasianellus columbianus.
 Lipeurus perplexus.
 Goniodes mammillatus.
Elanus leucurus.
 Nirmus fuscus.
Accipiter atricapillus striatulus.
 Nirmus fuscus.
Buteo borealis calurus.
 Nirmus fuscus.
Aquila chrysaëtos.
 Docophorus pictus.
 Colpocephalum flavescens.
Haliaeetus pelagicus.
 Colpocephalum flavescens.
Falco sparverius deserticolus.
 Nirmus fuscus.
Asio wilsonianus.
 Docophorus cursor.
Syrnium nebulosum.
 Docophorus speotyti.
Scotiaptex cinerea.
 Oncophorus remotus.
Nyctea nyctea.
 Docophorus ceblebrachys.
Dryobates pubescens gairdnerii.
 Menopon funereum.
Dryobates nuttallii.
 Docophorus singularis.
Xenopicus albolarvatus.
 Docophorus californiensis.
Sphyrapicus thyroideus.
 Docophorus californiensis.

- Melanerpes formicivorus bairdi*.
Docophorus californiensis.
Trochilus alexandri.
Nirmus vulgatus.
Calypte costæ.
Physostomum prominens.
Tyrannus verticalis.
Nirmus fœdus.
Myiarchus cinerascens.
Docophorus communis.
 rufus.
 fusco-ventralis.
Nirmus vulgatus.
 fœdus.
Physostomum sp.
Menopon distinctum.
Sayornis saya.
Nirmus fœdus.
Physostomum sp.
Contopus richardsonii.
Physostomum sp.
Empidonax difficilis.
Docophorus communis.
Nirmus vulgatus.
 ductilis.
Physostomum sp. *sucinaceum*.
Otocoris alpestris chrysolæma.
Docophorus communis.
Cyanocitta stelleri frontalis.
Docophorus communis.
Nirmus vulgatus.
Aphelocoma californica.
Docophorus communis.
Menopon persignatum.
Sturnella magna neglecta.
Docophorus communis.
Scolecophagus cyanocephalus.
Docophorus communis.
Coccothraustes vespertinus montanus.
Menopon funereum.
Carpodacus mexicanus frontalis.
Nirmus vulgatus.
- Spinus pinus*.
Docophorus communis.
Chondestes grammacus strigatus.
Docophorus communis.
Nirmus vulgatus.
Menopon incertum.
Zonotrichia leucophrys intermedia.
Docophorus communis.
Zonotrichia leucophrys gambelii.
Docophorus communis.
Zonotrichia coronata.
Docophorus communis.
Nirmus vulgatus.
Menopon mæstum.
Spizella sp.
Docophorus communis.
Spizella socialis arizonæ.
Docophorus communis.
Junco hyemalis oregonus.
Physostomum diffusum.
Junco hyemalis thurberi.
Docophorus mirinotatus.
Amphispiza belli.
Docophorus communis.
Nirmus lautiusculus.
Melospiza fasciata heermanni.
Colpocephalum grandiculum.
Melospiza fasciata samuelis.
Docophorus communis.
Physostomum sp.
Menopon mæstum.
Pipilo maculatus megalonyx.
Nirmus vulgatus.
Physostomum sp.
Pipilo fuscus crissalis.
Docophorus communis.
Nirmus vulgatus.
Colpocephalum grandiculum.
Physostomum sp.
Zamelodia melanocephala.
Docophorus communis.
Gniraca cærulea eurhyncha.
Docophorus communis.
Nirmus vulgatus.

- Passerina amoena.*
 Nirmus vulgatus.
Piranga ludoviciana.
 Docophorus commuais.
Petrochelidon lunifrons.
 Menopou mallens.
Chelidon erythrogastra.
 Nirmus longus var. *domesticus.*
Ampelis cedrorum.
 Docophorus communis.
 Nirmus brachythorax.
 Physostomum sp.
Phainopepla nitens.
 Nirmus fœdus.
Lanius borealis.
 Docophorus communis.
Lanius ludovicianus gambeli.
 Docophorus commuais.
 Nirmus fœdus.
Vireo solitarius plumbeus.
 Docophorus commuais.
Vireo bellii pusillus.
 Physostomum sp.
Helminthophila celata lutescens.
 Nirmus vulgatus.
Dendroica æstiva.
 Docophorus communis.
- Dendroica æstiva.*
 Nirmus vulgatus.
 Menopou ridulosum.
Icteria virens longicauda.
 Nirmus fœdus.
Cinclus mexicanus.
 Nirmus vulgatus.
Heleodytes brunneicapillus.
 Menopou mallens.
 distinctum.
Thryothorus bewickii spilurus.
 Docophorus communis.
 mirus.
 Menopon incertum.
Parus inornatus.
 Docophorus communis.
Parus gambeli.
 Nirmus vulgatus.
Parus rufescens uglectus.
 Nirmus vulgatus.
Turdus ustulatus.
 Menopon incertum.
Turdus aequalaschkæ auduboni.
 Docophorus communis.
Sialia mexicana occidentalis.
 Docophorus commuais.
 Nirmus vulgatus.

EXPLANATION OF PLATES.

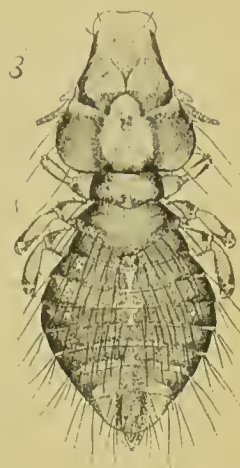
PLATE V.—Fig. 1, *Docophorus procax* Kellogg and Chapman, ♀. Fig. 2, *D. validus* Kellogg and Chapman, ♀. Fig. 3, *D. fusiformis* Denny, ♂. Fig. 4, *D. pictus* Giebel, ♀. Fig. 5, *D. singularis* Kellogg and Chapman, ♀. Fig. 6, *D. mirinotatus* Kellogg and Chapman, ♀. Fig. 7, *D. mirus* Kellogg and Chapman, ♀. Fig. 8, *Nirmus pacifeus* Kellogg and Chapman, ♀. Fig. 9, *N. fusco-marginatus* Denny, var. *americanus* Kellogg and Chapman, ♀.

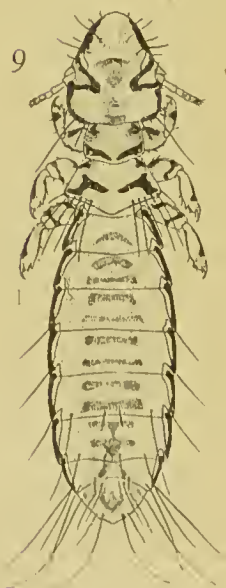
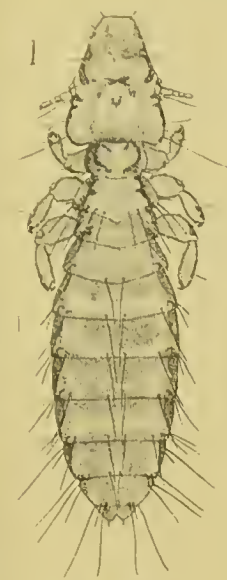
PLATE VI.—Fig. 1, *Nirmus maritimus* Kellogg and Chapman, ♀. Fig. 2, *N. triangulatus* Nitzsch, ♀. Fig. 3, *N. complexivus* Kellogg and Chapman, ♀. Fig. 4, *N. aetophilus* Kellogg and Chapman, ♀. Fig. 5, *N. incœnis* Kellogg and Chapman, ♀. Fig. 6, *N. opæus* Kellogg and Chapman, ♀. Fig. 7, *N. fœdus* Kellogg and Chapman, ♀. Fig. 8, *N. ductilis* Kellogg and Chapman, ♀. Fig. 9, *N. lautiusculus* Kellogg and Chapman, ♂.

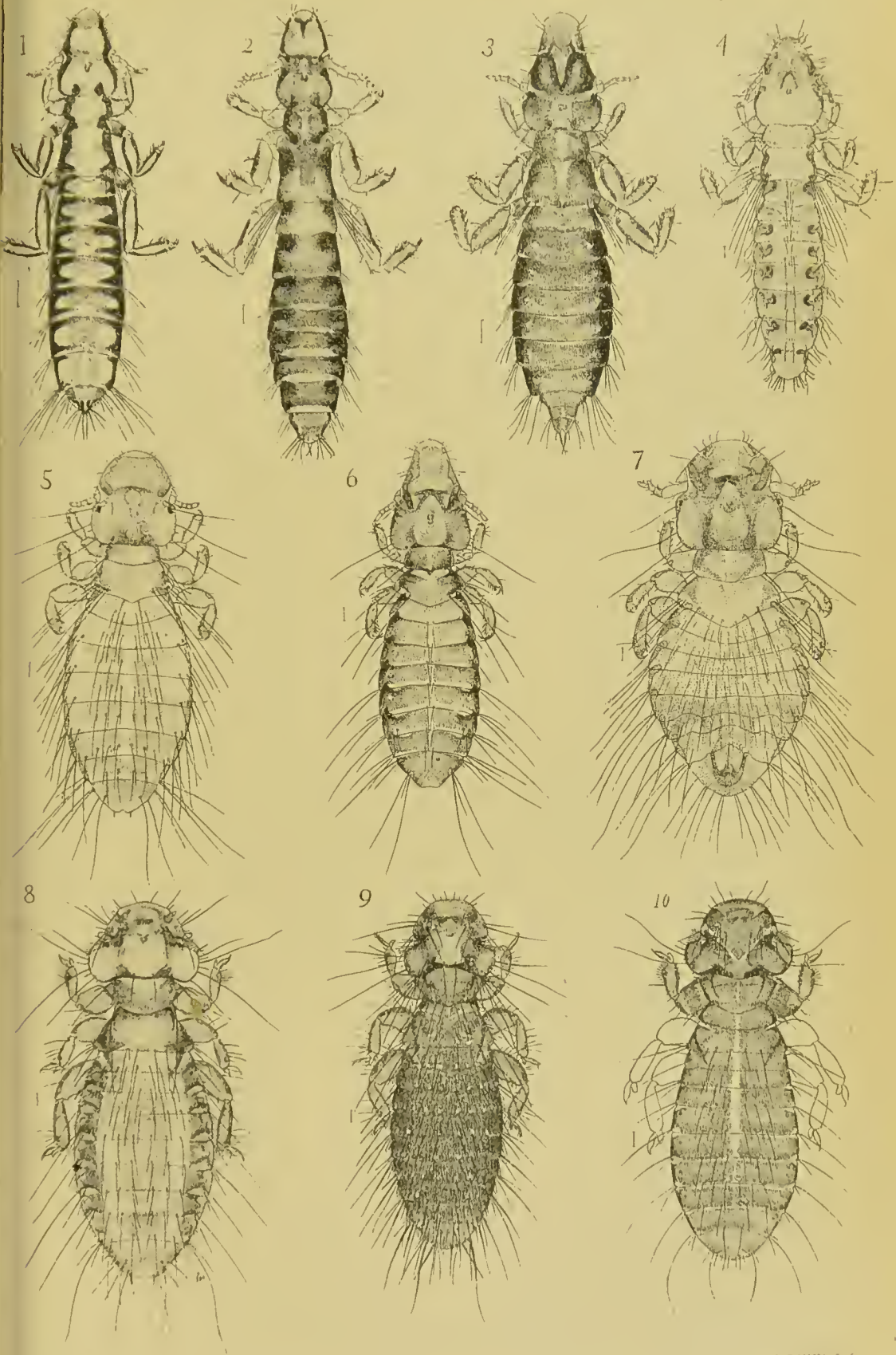
PLATE VII.—Fig. 1, *Lipeurus laeulatus* Kellogg and Chapman, ♂. Fig. 2, *L. concinnus* Kellogg and Chapman, ♂. Fig. 3, *L. fuliginosus* Taschenberg, var. *major* Kellogg and Chapman, ♂. Fig. 4, *L. faralloni* Kellogg, ♂. Fig. 5, *L. perplexus* Kellogg and Chapman, ♀. Fig. 6, *Oneophorus bisetosus* Piaget, var. *californicus* Kellogg and Chapman, ♀. Fig. 7, *O. remotus* Kellogg and Chapman, ♂. Fig. 8, *Celipocephalum perplanum* Kellogg and Chapman, ♀. Fig. 9, *C. spinulosum* Piaget, var. *minor* Kellogg and Chapman, ♂. Fig. 10, *C. grandieulum* Kellogg and Chapman, ♀.

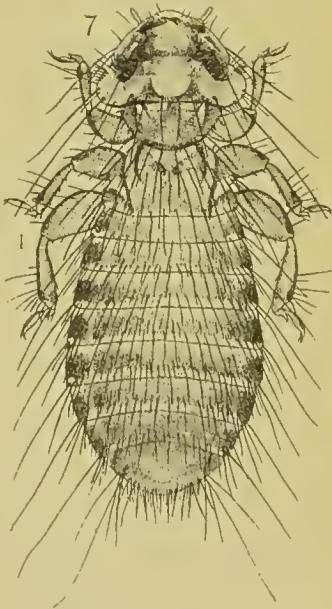
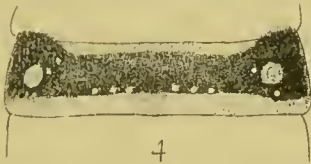
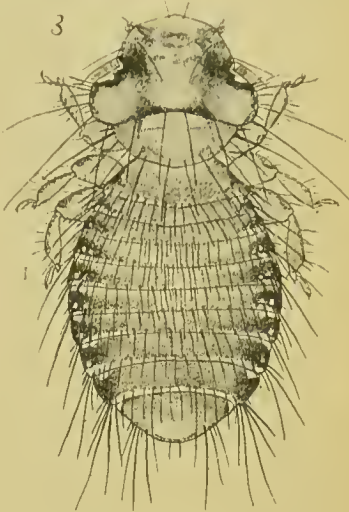
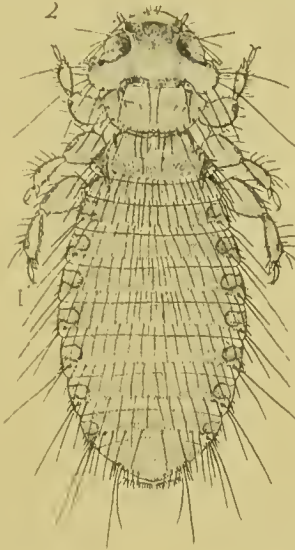
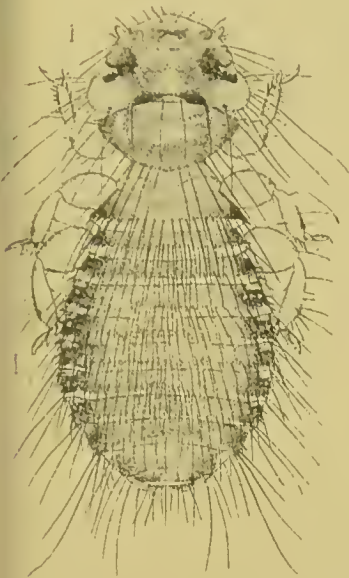
PLATE VIII.—Fig. 1, *Menopon irrumpens* Kellogg and Chapman, ♀. Fig. 2, *M. paululum* Kellogg and Chapman, ♀. Fig. 3, *M. petulans* Kellogg and Chapman, ♂. Fig. 4, *M. titan* Piaget, var. *incompositum* Kellogg and Chapman, dorsal aspect of one abdominal segment. Fig. 5, *M. titan* Piaget, var. *incompositum* Kellogg and Chapman, ventral aspect of last segments of abdomen of ♂. Fig. 6, *M. funereum* Kellogg and Chapman, ♂. Fig. 7, *M. distinctum* Kellogg and Chapman, ♀.

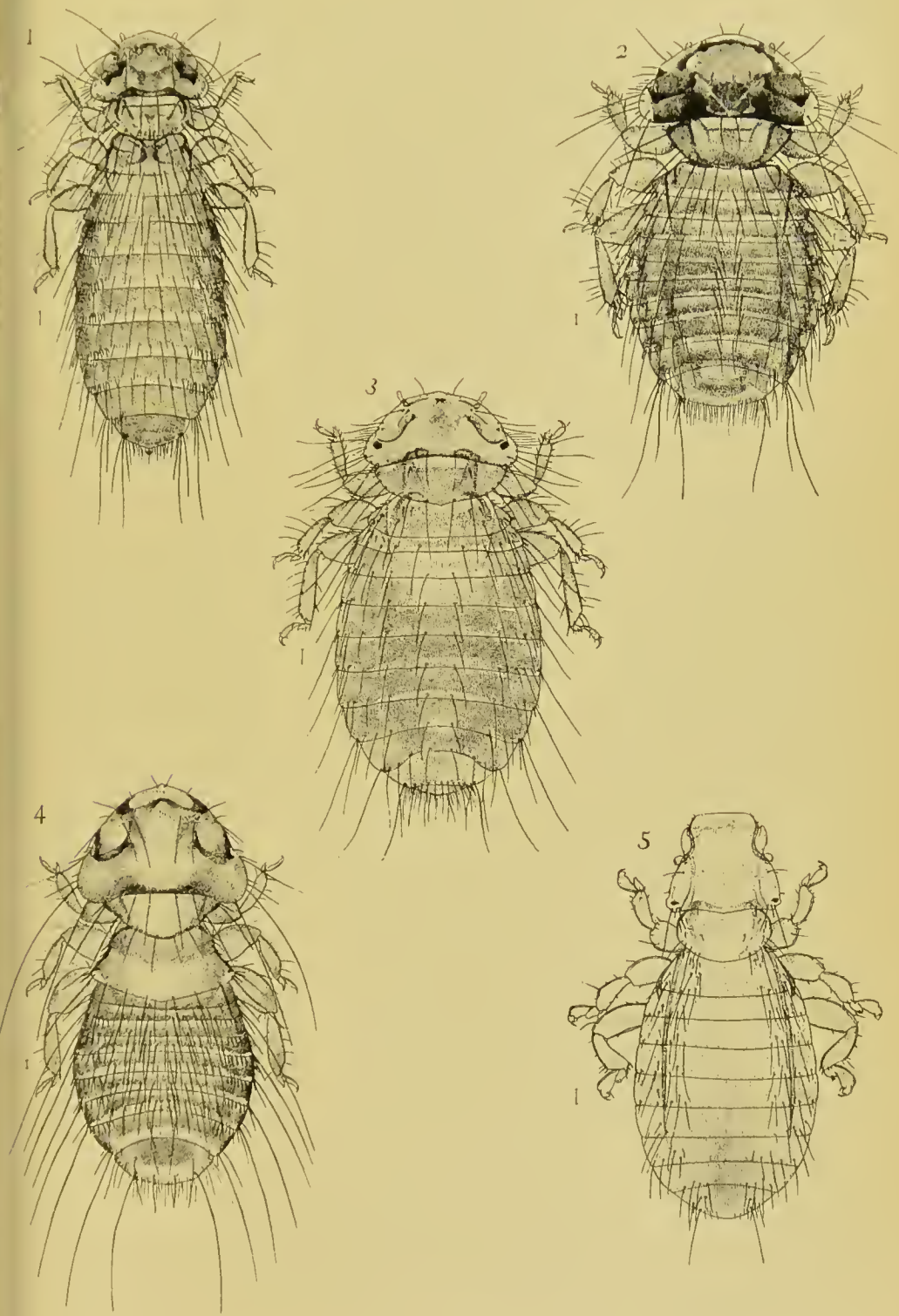
PLATE IX.—Fig. 1, *Menopon persignatum* Kellogg and Chapman, ♀. Fig. 2, *M. mastum* Kellogg and Chapman, ♀. Fig. 3, *M. malleus* Nitzsch, ♀. Fig. 4, *M. ridulosum* Kellogg and Chapman, ♀. Fig. 5, *Physostomum prominens* Kellogg and Chapman.











THE ANATOMY OF THE MALLOPHAGA.

(With Plates X to XVII.)

BY ROBERT E. SNODGRASS.

The earliest work on the anatomy of the Mallophaga is that of Nitzsch. His results are comprised in his own announcement of his work, "Darstellung der Familien und Gattungen der Thierinsekten (insecta epizoica) als Prodrömus einer Naturgeschichte derselben," published in the third volume of Germar and Zinken's "Magazin für die Entomologie," 1818, and in Giebel's "Insecta Epizoa, die auf Säugethieren und Vögeln schmarotzenden Insecten, nach Chr. L. Nitzsch's Nachlass bearbeitet," published in 1874. Both of these works are chiefly systematic, but the larger groups are separated on anatomical characters. The first purely anatomical paper is one by Wedl in 1855, "Ueber das Herz von *Menopon pallidum*." This paper is limited to a single organ. The next, by Kramer, "Beiträge zur Anatomie und Physiologie der Gattung *Philoapterus* (Nitzsch)," published in Zeitschrift für Zoologie in 1869, includes all the organs of a single species (*Lipeurus jejunus*). The third and latest purely anatomical paper is Grosse's "Beiträge zur Kenntniss der Mallophagen," published in the same journal as the last, in 1885. *Menopon titan* (*Tetrophthalmus chilensis* Grosse), is made the basis for detailed descriptions, but the work is comparative, since more general descriptions of other forms are given, and the anatomical characters of the two main groups are pointed out. In 1869 Rudow published a paper, "Beobachtungen über die Lebensweise und der Bau der Mallophagen oder Pelzfresser, sowie Beschreibung neuer Arten," in which the

principal anatomical characters are tabulated, and a long description of the mouth-parts given. The latter, however, is almost entirely incorrect. The mouth-parts were described wrongly at first by Nitzsch, then by Kramer, and finally by Rudow. Their correct explanation is due to Grosse. Rudow's paper contains an important statement concerning the number of egg-tubules in *Amblyceran* females. He says that there are five present of which two are rudimentary. Nitzsch could find but three, and Grosse apparently made no determination of the number present. In 1869, also, Melnikow published in *Archiv für Naturgeschichte*, vol. xxxv, an embryological paper, "Beiträge zur Embryonal-entwicklung der Insekten" in which the embryology of the Mallophaga is described. Nusbaum in his paper, "Zur Entwicklungsgeschichte der Ausführungsgänge der Sexualdrüsen bei den Insekten," in *Zoologischer Anzeiger* for 1882, describes mainly two Mallophagan species, *Lipeurus bacillus* and *Goniocotes hologaster*.

I. GENERAL EXTERNAL ANATOMY.

External Form and Body-wall.—The body is generally very much flattened dorsoventrally. The segments of the thorax are often apparently only two, the mesonotum and metanotum being united. In others, however, the two are distinct although the former is narrow. In longitudinal sections of *Menopon titan* (plate x, fig. 1), the mesonotum (T_2) is seen to be separated from the metanotum (T_3) by a non-chitinized space, and is depressed below the level of the latter. The number of abdominal segments varies, but the largest is ten. The number in some cases varies with the sex. The head is flat, horizontal, situated closely

upon the prothorax, and often excavated behind to receive the latter. In *Menopon persignatum*, as shown by transverse sections (plate xii), the head is very flat and comparatively wide. The side walls are very far from being perpendicular, and are scarcely distinguishable from the dorsal walls. They meet the floor of the cranium at a sharp angle. The top of the head is flat in front, somewhat concave behind. The prothorax is triangular in cross-section, having one angle median and ventral. The tergum is a little rounded. The mesothorax is more convex above and flatter beneath. The lateral edges are sharp and project over the bases of the legs. The metathorax is wider but otherwise similar to the mesothorax except in length. In the females of some species the abdomen is little or not at all flattened.

The body-wall of most species is well chitinized. In the abdomen the chitin is deposited in several areas around each segment (plate xv, figs. 3, 4, and 5, and plate xvii, figs. 1-5). On the dorsal side is a wide continuous plate reaching on each side to a short distance from the lateral margin of the segment. Likewise on the ventral side is a similar chitinization, and the two plates form respectively the tergum and sternum of the segment. Laterally, between the outer ends of these, are angular plates, one on each side, forming the lateral walls or pleura of the segment. The four are separated from one another by non-chitinized spaces. The intersegmental spaces are generally, especially on the dorsum, thrown into S-shaped folds, so that the posterior end of one segment overlaps the anterior end of the one in front. In some cases the chitinous tergum or sternum of a segment occupies only a small part of its length. In some the chitin is mostly accumulated

at one place. An extreme example is shown in the terga of the anterior abdominal segments of *Eurymetopus taurus*. Here the chitin shows in longitudinal sections a large oval thickening near the anterior end of the segment, back of which it forms only a thin superficial plate reaching to near the posterior end. Anteriorly it terminates in a deeper but very short prolongation. The non-chitinized part in front is folded into a strong S-shaped band, the upper loop of which, forming the posterior border of the segment in front, projects over the anterior end of the chitinous thickening. Processes of the chitinous wall often extend into the body-cavity, especially in the thorax, giving attachment to various muscles. The antennary fossæ of the Amblycera are formed by chitinous processes from the lateral ventral margins of the head extending outward beneath the antennæ, and by a prolongation of the outer dorsal aspects of the head outward and downward (plate xii, figs. 1 and 2). Chitinous genital parts will be described under the head of the Reproductive Organs.

The Appendages.—The antennæ are three to five-jointed. In the Amblycera they are concealed in deep fossæ on the lateral ventral aspects of the head, and generally have the terminal segment enlarged. In the Ischnocera they are simple, filiform and exposed.

The mouth-parts have already been described in detail in Kellogg's "New Mallophaga, II,"* and merely a general account of their structure will be given here. They are of the biting type and consist of mandibles, maxillæ, and labium. The maxillæ (plate x, figs. 5, 6, 11 and 12) are large, strong, triangular, two-toothed

* Proc. Cal. Acad. Sci., 2nd Ser., Vol. VI, 1896.

structures, attached to the head by a condyle on one side and a socket on the opposite side of the outer basal angle. From the inner angle of the base a prolongation extends inward. The two teeth project from the inner edge, generally one distal to the other. The mandibles present two modifications, one found in the Amblycera and the other in the Ischnocera. In the former they lie parallel with the ventral surface of the head, so that the condyle is ventral and the socket dorsal. In this form one tooth lies in front of the other in a horizontal line in the same plane as the long axis of the mandible. In the Ischnocera the mandibles hang vertical to the head, so that the condyle is posterior and the socket anterior. In this form the distal tooth is typically ventral to the other in a vertical line in the same plane as the long axis of the mandible. The more proximal tooth, however, may be moved toward the tip and come to lie by the other and in front of it (plate x, fig. 6). In this case the two lie in the same horizontal line, but this is perpendicular to the long axis of the mandible. Starting with either type, the other may be produced from it by revolving the mandible on an axis passing from its outer to its inner basal angles. The degree of revolution varies in different Ischnoceran species, but the angle is always large and may reach 90° . In many cases there is a chitinous plate or rod attached to the inner angle of the base of the mandible, and a smaller one attached to the outer. These serve for attachment of muscles (plate x, fig. 12, *ch. pls.*) extending backward or upward into the head cavity. When they are absent muscle fibers are attached directly to the mandibles.

The maxillæ are generally simple, small, non-chitinated lobes, often provided with teeth on their inner

edges. They lack palpi and distinct divisions into the ordinary parts (plate x, figs. 3 and 10).

The labium presents two forms, one in the Amblycera the other in the Ischnocera. In the former (plate x, fig. 9), there are present a submentum, mentum with two four-segmented palpi, and a ligula with two glossæ and two paraglossæ. The ligula is the only part that varies much, since it may have more or fewer than the four lobes named. In the Ischnocera a submentum, mentum, and ligula are present. The latter two are not well separated, but the paraglossæ are distinct (plate x, fig. 13) and very constant in form, being short, thick, cylindrical, and rather more chitinized than the rest of the labium. The glossæ are present between the paraglossæ as two small lobes.

In front of the mouth is the labrum, a large lobe situated on the ventral aspect of the head, generally some distance back of the anterior border of the clypeus.

The three pairs of legs are very similar throughout the group. The tarsi are two-jointed, and, with the exception of two genera, *Trichodectes* and *Gyropus*, that inhabit mammals, are provided with two claws, the others having only one. In some specimens of *Docophorus cursor* examined, the legs when at rest generally assumed the following positions. The femur (fig. 1) of the metathoracic leg extends outward and is inclined slightly forward

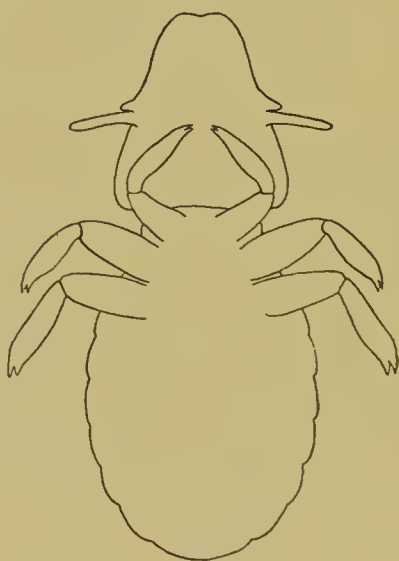


Fig. 1.

from the body. The femur of the mesothoracic leg extends outward also but a little more forward than the other. That of the prothoracic leg is inclined forward at an angle of about 45° with the body. Hence the fore legs are held mostly beneath the head and anterior part of the prothorax. The meta- and mesotibiae extend backward, outward, and downward from the distal ends of the corresponding femora. The protibiae extend backward, inward, and downward from the

distal ends of the profemora, and their distal ends lie internal to the coxal ends of the femora.

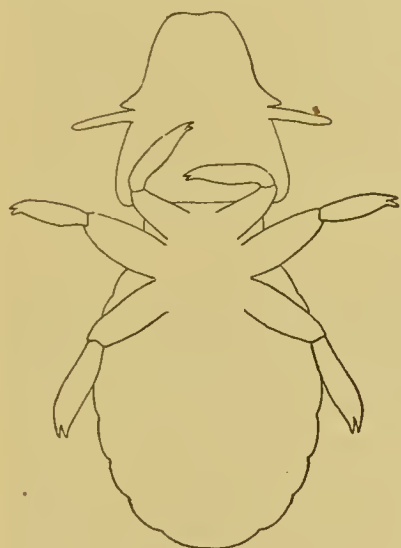


Fig. 2.

When the insect is walking undisturbed in forward longitudinal progression, the two legs of the mesothorax and of the metathorax move respectively together, but the two pairs move in opposite directions. That is (figs. 2 and 3), the two mesothoracic legs move forward or backward at the same time and the metathoracic legs move in the same

manner, but while the mesothoracic legs are moving forward, the metathoracic legs are moving backward, and *vice versa*. Thus, while one pair of legs is pushing the body forward the other pair is reaching forward for a new grasp, and this is obtained just as the active pair has finished its work. The pair previously being carried forward then takes hold and continues the motion of the body, the two being themselves brought relatively backward. In this way the two pairs are

always either approaching each other or are receding from each other.

The prothoracic legs do not move synchronously with either of the other pairs nor with each other. Generally (fig. 3) one moves backwards while the other is reaching forward. They appear mainly to guide the body. The femoro-tibial joint is most of the time in front of the tarsal claws, so that their power as propellers cannot be great. The parasite



Fig. 3.

thus progresses along the feather with a hand over hand movement of the prothoracic legs, as of a man climbing a rope, while the other legs, a pair at a time, are continually pushing the body forward.

This is the typical movement of the legs and the one which prevails when the insects are walking quietly and regularly, but at times it becomes very much obscured by irregular movements and is generally more or less so, so that almost any relative position of the legs may be seen. The outer end of the metathoracic femur is seldom brought much farther forward than its coxa. The mesothoracic femur forms a smaller angle with the body in front, but not such a small one behind as the metathoracic leg. The femoro-tibial joints of the prothoracic legs are during progression brought forward, and the tibia also independently turns forward on the femur, so that the angle between the two increases and the tarsal claws are carried forward

by a double motion. They then grasp the feather and by their own motion backward and by the motion of the body forward on the hind legs the femoro-tibial angle is again decreased and the leg assumes its former position. The insects run along on the feathers very easily, generally preferring the shaft. Those experimented with were kept on a few bits of feather on a glass slide. They ran along the shaft of a feather until they came to the end, then backed up a short distance, turned around, and ran back to the other end to go through the same performance there. They generally move with the head forward but can apparently go backwards or at any lateral angle just as easily; they nearly always, however, turn around when they wish to reverse the direction of movement. When several were placed on some guinea-pig hairs they appeared to be at no loss at all as to how to get along, and traveled just as well as on the feathers, although perhaps a little slower. Some Pediculids, however, from the guinea-pig, when placed on some feathers, appeared to be somewhat hindered by the network of barbs and barbules. The Mallophaga were entirely unable to progress upon the glass slide when they got off of the feathers, but the lice showed no difficulty at all in this respect; the latter could also right themselves when placed on their backs while the former could not.

II. THE ALIMENTARY CANAL AND ITS APPENDAGES.

The Alimentary Canal.—The alimentary canal presents two types of structure. One form is simple, having no special development at any part, the other is complicated by a lateral and backward prolongation of the crop, so that the latter forms a large expanded diverticulum of the œsophagus. The first form is confined to

the Amblycera, the second to the Ischnocera. Of the first, the alimentary canal of *Menopon titan* (plate xi, fig. 13, plate x, fig. 1, and plate xvii, fig. 6) may be taken as an example. It has the form of an almost straight tube separable into six distinct parts. The first of these is a narrow elongated buccal cavity (plate x, fig. 1, *bc*) extending upward and backward from the oval aperture, by which it opens anteriorly, to the second part of the alimentary canal, the pharynx (*p*). This is a large cavity, oval in longitudinal sections, having its long axis extending backward and upward, but not so much in the latter direction as that of the buccal cavity, so that the two form an angle with each other. The pharynx lies mostly in front of the brain (*b*) and subœsophageal ganglion (*s.œ. g.*), the commissures lying laterad of its posterior end. Between the latter the pharynx contracts and passes into the œsophagus. This is rather long, narrow, gradually expands posteriorly, passes uninterruptedly into the crop, and forms with the latter the third division of the alimentary canal (*œ* and *cr*). The crop is of variable size according to the contents, but is rather large when distended.

The fourth part, the ventriculus, is long, wide in front and narrow behind, and connected with the crop in front by a short, very narrow neck. On each side of this it is produced into a large cæcum, the two embracing the posterior end of the crop. Back of the stomach is the intestine forming the fifth and sixth divisions of the alimentary tract. The first of these two consists of the prerectal part of the intestine and the second of rectum. The former is a short, straight, narrow tube, a little enlarged toward the middle and separated from the ventriculus in front and the rectum

behind by slight constrictions. From its anterior end four Malpighian tubules arise. The rectum is very large (plate xi, fig. 13, and plate xvii, fig. 6, *r*). Its anterior part is much dilated, the enlargement being rather suddenly narrowed in front, but posteriorly gradually passes into the more tubular posterior part. Its anterior end is provided with six oval rectal glands. These vary in size in different specimens. In the male the anal opening is in the upper posterior part of the genital chamber, in the female it is in the end of the last abdominal segment (plate xv, figs. 1 and 2, *a*, and plate xvii, fig. 6, *a*).

Sections show the following histological features of the alimentary canal. The preventricular part is lined with a chitinous intima continuous with the body-covering at the mouth. The ventriculus lacks an intima, but possesses a thick inner cellular epithelium (plate x, fig. 1, *v*). The intestine has a thin chitinous lining continuous with the body-covering at the anus. The prerectal part possesses a thin cellular epithelium covered by an outer membrane, surrounding which are small muscle fibers. The rectum lacks the epithelium and has larger muscle fibers (plate xvii, fig. 6, *rtm*). The rectal glands project inwardly and are covered by the chitinous lining of this part of the alimentary tract.

In the Ischnocera, as before stated, the alimentary canal is complicated by a very remarkable condition of the crop. This in the genus *Trichodectes* has the form of a large sac connected with the lower end of the œsophagus by a long, narrow neck; in the other genera it forms a large transverse dilatation of the œsophagus, some distance above where the latter opens into the ventriculus. The crop is always produced much

more to one side of the œsophagus than to the other.

The alimentary canal of *Eurymetopus taurus* may be taken as a type of this latter form (plate xi, fig. 11). The œsophagus is a long, slender tube reaching from the head to the mesothorax. Here it enters the anterior dorsal aspect of the crop. The latter lies dorsal and to the left of the other organs of the body-cavity except the heart, and extends from the middle line backwards and to the left, reaching the sixth abdominal segment when considerably distended. Its size and shape vary according to its contents, but it is generally much longer than wide, rounded in front, swollen toward the middle, and tapering behind. Its upper end extends a short distance beyond the opening of the œsophagus into it. About opposite the latter point, on the ventral aspect of the crop, the subingluvial part of the œsophagus begins and runs backwards to the ventriculus, forming a short, narrow tube. The ventriculus is smaller than the crop when the latter is fully distended. Anteriorly it bears two large, lobular cæca, each being rather flat and expanded beyond its base. The stomach lies with most of its long axis in an antero-posterior direction. It is widest through the middle; in front of this it is slightly constricted, while in the opposite direction it becomes very much narrowed, and, assuming a tubular form, makes a bend to the left. It goes a short distance in this direction and then meets the hind-gut. The latter turns immediately backward and runs in a straight line to the exterior. It is divided into an anterior, narrow, prerectal part and a posterior, enlarged rectum. The former bears at its anterior end the four Malpighian tubules, becomes enlarged toward its middle, and is separated posteriorly from the rectum by a slight constriction. The latter is much distended

in front, where six large, oval, rectal glands are situated, but becomes narrowed posteriorly, the hind half being a straight, narrow tube opening into the upper part of the genital cavity. The relative size and shape of each of these parts vary greatly with their contents. The crop is provided with very prominent longitudinal and transverse muscles, which form a network of fibers over it.

It is evident that in such an alimentary canal as that just described there are two distinct divisions in addition to those of the alimentary canal of an Amblyeeran species. The crop of *Eurymetopus* forms a part distinct and sharply separated from the œsophagus in front, and also sets off that portion of the œsophagus between itself and the stomach as a distinct division of the alimentary tract. The bits of feathers that form the food of the insect are generally almost as long as the crop and always lie in it in a longitudinal direction.

The alimentary canals of all other Philopterids in which this organ is known are similar in all essential respects to that of *Eurymetopus taurus* just described. In *Docophorus lari* the crop is very much like that of *Eurymetopus taurus* in shape (plate xi, fig. 8). It extends from the anterior left part of the body-cavity backwards and to the right. The œsophagus is narrow, lies in the middle line, and enters the crop some distance to the right of the anterior end of the latter. Arising from the ventral surface of the crop, at a point some distance to the left of the opening of the anterior part of the œsophagus into the same, is the subingluvial part of the œsophagus, which passes backwards a short distance and enters the ventriculus. This is rather long and tapers very much posteriorly. Its anterior end is provided with a large, lobe-like cæcum on

each side. Its posterior end is a little bent just before it enters the hind-gut. The latter is short and narrow. The rectum is very much expanded anteriorly, having six prominent rectal glands surrounding the posterior end of the anterior smaller part of the intestine.

In *Goniodes cervinicornis* the crop is relatively very long and tapering (plate xi, fig. 12). It lies in an almost antero-posterior direction to the left of the rest of the alimentary canal. Its anterior end is large and rounded; posteriorly it tapers to a rather pointed extremity which reaches a little farther back than the posterior end of the ventriculus. When in the natural position its hind end is bent to the right and lies close to the stomach. The œsophagus enters the crop on its dorsal surface back of the anterior end. The part of the œsophagus between the crop and the stomach arises from the former in front of the point at which the anterior portion of the œsophagus opens into it. The stomach is rather long, but when it is distended it does not taper very much posteriorly, passing into the intestine by a rather sudden constriction. The two cæca at its anterior ends are relatively smaller than in the other forms described, and are merely blunt diverticula of the ventriculus without constricted bases. The pre-rectal part of the intestine is very short and narrow. The rectum on the other hand is unusually large, having its anterior end very greatly dilated and provided with six very large and much elongated rectal glands.

In *Lipeurus fuliginosus major* the crop lies to the left side of the body-cavity, the rest of the canal lying along the right. The ventriculus simply contracts posteriorly, passing gradually into the intestine, the two being separated by only a slight constriction. The rectum is comparatively rather long but otherwise both it

and the rest of the intestine are very similar to the others described.

Nitzsch (1874) figures the alimentary canals of the following Philopterid species: *Docophorus fuscicollis*, *D. ocellatus*, and *Lipeurus jejunus*. That of *Docophorus fuscicollis* differs in no essential respect from those forms already described. In *D. ocellatus* the openings of the pre- and postingluvial divisions of the œsophagus are rather far removed from the nearer end of the crop. The ventriculus is very long and bent upon itself, forming a loop.

The genus *Trichodectes* (family Trichodectidæ) presents a rather remarkable deviation from the other Ischnoceran forms in the shape and position of the crop. As already mentioned, it is of the form of a sack connected with the œsophagus some distance in front of the ventriculus by a narrow, more or less elongated neck. In *Trichodectes geomydis* (plate xi, fig. 10), the crop is rather smaller comparatively than in most of the Philopterid forms, being about two-thirds the length of the stomach. The neck is long and slender, extending laterally from the œsophagus. The ventriculus is large anteriorly, where it is produced into two large cæca which are not constricted at their bases. Posteriorly the stomach becomes narrowed and makes an abrupt bend in the direction of the crop. After running a short distance in this direction as a narrow tube it passes into the intestine. This division of the alimentary canal goes backward from the midgut, forming a right angle with the posterior tubular part of the latter. The rectum is wide anteriorly, where it presents six glands as in the other families. In a *Trichodectes* from a horse the crop (plate xi, fig. 9) is the same as in *T. geomydis*, but is comparatively even a little smaller;

also, the neck is shorter. The ventriculus with its large gastric cæca is about the same. Nitzsch (1874) figures the alimentary canal of *T. climax*. Here the crop differs somewhat from the two just described in that the neck is very much shorter, the crop forming a pear-shaped diverticulum from the side of the œsophagus and separated from it by a narrow constriction. In this form the distal end of the crop is the larger, while in the Philopterid forms the proximal end is the larger, the distal end being generally more or less tapering and pointed. No intermediate form of a crop between the Philopterid and Trichodectid types has been found, and it is impossible to say which is the more primitive.

Pharyngeal Sclerite.—In many genera, including all of those of the Ischnocera, and one and part of another genus in the Amblycera, there is present a curiously formed sclerite in the walls of the pharynx. It has already been described in Kellogg's "New Mallophaga, II," under the term "œsophageal sclerite." As shown there, it is a prominent, cup-shaped thickening of the chitinous lining of the ventral wall of the pharynx, forming a depression in the latter. From its sides (plate x, fig. 7) chitinous bands (*bs*) run upward around the pharynx and are connected by muscles with the dorsal wall of the head. From the anterior corners a large expansion (*ant. h*) on each side reaches forward and upward in the walls of the pharynx. Into the anterior end of its cavity a duct from two ventrally situated glands opens. The latter (plate x, fig. 2, *l.g.*) are oval, covered with a chitinous envelope, and supported by chitinous pedicles. From the anterior end of each a duct runs forward, after traversing the ventral surface, and then turns inward and backward to unite with the duct

from the other side. The common duct thus formed then goes straight back to the sclerite. The shape of both these organs is very remarkably constant. In one or two genera they present deviations, and also in a few scattered cases, but these will be described farther on.

As was pointed out by Kellogg (1896), these organs are not peculiar to the Mallophaga but occur also in the Psocidæ, having been described for these insects by Burgess (1878). Outside of these two groups, however, they are not known to occur. Among the Mallophaga they are not of universal occurrence, but are for the most part confined to one suborder. Specimens of the following genera were had for examination: *Ancistrona*, *Colpocephalum*, *Docophorus*, *Eurymetopus*, *Giebelia*, *Goniocotes*, *Goniodes*, *Læmobothrium*, *Lipeurus*, *Menopon*, *Nirmus*, *Nitzschia*, *Oncophorus*, *Physostomum*, *Trichodectes*, *Trinoton*. The following table shows the distribution of the sclerite and glands among these genera:

Genera with Sclerite and Glands Present.	Genera with Sclerite and Glands Absent.	Genera with Sclerite and Glands Present or Absent.
<i>Colpocephalum</i> .	<i>Ancistrona</i> .	<i>Docophorus</i> .
<i>Eurymetopus</i> .	<i>Læmobothrium</i> .	<i>Lipeurus</i> .
<i>Giebelia</i> .	<i>Nitzschia</i> .	<i>Menopon</i> .
<i>Goniocotes</i> .	<i>Physostomum</i> .	<i>Nirmus</i> .
<i>Goniodes</i> .	<i>Trinoton</i> .	
<i>Oncophorus</i> .		
<i>Trichodectes</i> .		

The above table shows that those genera with the structures present belong, with the exception of *Colpocephalum*, to the suborder Isehnocera; while those in which they are absent belong, without exception, to the suborder Amblycera. Hence there are no Ischnoceran genera in which the sclerite and glands are absent in all

species, although in three genera they are absent in a few cases. On the other hand, in the Amblycera they are absent in all but two genera, and of these one has them present in all species, but in the other they may be present or may be absent. Of thirty-eight species of *Docophorus*, twenty-six species of *Lipeurus*, and twenty-nine species of *Nirmus* examined—all that were accessible—only in *Docophorus icterodes*, *Lipeurus picturatus*, *L. longipilus*, and *Nirmus signatus* are the structures absent. From this it is evident that the exceptions to the occurrence of the œsophageal sclerite and glands in North American Ischnocera are few. It is worthy of notice also that the species of this suborder lacking them occur in the three largest genera,—the species of *Docophorus*, *Lipeurus*, and *Nirmus* being far more numerous than those of all the other genera of the same suborder together.

The following genera have been found so far only on European birds, *Akidoproctus*, *Boopia*, *Bothriometopus*, *Eureum*, and *Ornithobius*. Taschenberg (1882) and Piaget (1880), however, give good figures of all these genera, and in their figures the presence or absence of the sclerite is apparently intended to be shown, although whether it is or is not present is not stated in the description of each species. The figures can probably be relied on to show at least in what species it is present. According to them the structure is present only in *Akidoproctus*. This genus and also *Bothriometopus* and *Ornithobius* belong to the Ischnocera, so that it appears that there are two genera of this suborder in which the sclerite is absent; but this is without proof. If it is absent in the two Amblyceran genera, *Boopia* and *Eureum*, they agree with most of the other forms of their suborder. The sclerite appears to be absent

also in *Gyropus*, an Amblyeeran mammal-infesting genus*

In some species of several genera the sclerite is not of the typical form described. In *Docophorus pertusus* it is very much modified in form. The body is comparatively very small and the anterior processes are not present at all. On the other hand, the lateral circum-oesophageal bands are greatly enlarged, forming a thick chitinous band passing upward around the pharynx. The body of the structure is so small that it appears merely as a median, backward-projecting enlargement of the rest. The dorsal cavity is present, its anterior wall and the anterior margins of the lateral wings are transparent and continuous with one another. The wings are expanded near their bases but distally each becomes narrowed and passes upward and somewhat forward as a slender curved rod. The structure is of about the same shape in a young specimen but the wings are proportionally smaller. In *Docophorus atricolor* the sclerite is small and weakly chitinized but the anterior processes are comparatively large and much expanded. In *Lipeurus diversus* the body is elongated, and in *L. squalidus* it is similar but with the anterior processes enlarged. In several other Ischnoceran genera the sclerite is variously modified, but the species in which modification occurs are scattered and not closely related to one another.

In the Amblyeera only two genera possess the pharyngeal sclerite, and in these two the characteristic form is not that of the Ischnoeera. It is, however, typically the

*Taschenberg figures *Bothriometopus macrocnemis*, ♂ and head of ♀, and *Ornithobius hexophthalmus*, ♀ and head of ♂, in which the sclerite is not shown. But in *Akidoproctus rostratus* and *A. stenopygos* it is plainly present. Piaget figures *Boopis longitarsus*, *B. grandis*, *Eureum ciminioides*, *E. malleus*, *Gyropus ovalis*, *G. gracilis*, and *G. turbinalis*, in all of which the sclerite is not shown.

same. In *Menopon* and *Colpocephalum* the anterior processes of the sclerite are very much prolonged forward and are only slightly divergent. In some cases the sclerite is extremely reduced in size. In *Menopon fædus* the anterior processes are not prolonged but are wide and bifid. These two genera are in other respects also very similar, and it is of significance that in the only genera of the Amblycera that possess the sclerite it has the same structure, different from that prevailing amongst the Ischnoceran genera, in each.

The following table gives the species of *Menopon* examined that have and do not have the sclerite and glands:

Genus <i>Menopon</i> .	
Species with Sclerite and Glands Present.	Species with Sclerite and Glands Absent.
<i>auro-fasciatum</i>	<i>distinctum</i>
<i>decoratum</i>	<i>malleus</i>
<i>dissimile</i>	<i>persignatum</i>
<i>fædus</i>	<i>præcursor</i>
<i>funereum</i>	<i>rediculosum</i>
<i>incertum</i>	<i>robustum</i>
<i>indistinctum</i>	<i>titian</i>
<i>infrequens</i>	<i>tridens</i>
<i>irrupens</i>	
<i>longicephalum</i>	
<i>loomisii</i>	
<i>melanorum</i>	
<i>mesoleucum</i>	
<i>monostæchum</i>	
<i>navigans</i>	
<i>numerosum</i>	
<i>paululum</i>	
<i>petulans</i>	
<i>striatum</i>	

It is evident that the œsophageal sclerite and connected glands might be made use of in determining the relations of *Menopon* and *Colpocephalum* to the other genera, and also of the Mallophaga to other orders of Insects, since they occur also in the Psocidæ. But the probable number of yet unknown species is too great to allow of these structures being used to determine relationships of genera within the order.

The Salivary Organs.—In 1869 Kramer described the salivary glands of *Lipeurus jejunus*. In 1874 they were mentioned by Giebel in "Insecta Epizoa" from Nitzsch's notes. He gives no description of them. Finally, in 1885, Grosse gave a general account of their structure in the whole order, and a special description of those of *Tetrophthalmus chilensis* (*Menopon titan*). As far as is known, all species of Mallophaga possess two pairs of salivary organs; in some cases there is evidence that only one of each pair is a gland, the other being a reservoir. In any case either one gland and a reservoir or two glands are situated on each side of the crop or œsophagus. From the anterior end of each organ a duct arises and passes forward. The two ducts on each side unite with each other, forming a right and left common salivary duct. These run forward a varying distance and then approach each other and unite in the middle line. This final duct formed of the four primary ducts runs forward beneath the œsophagus and enters the head where it opens into the pharynx.

In the suborder Amblycera the salivary organs appear to have no constant form characteristic of the subgroup. Grosse describes those of *Menopon titan* (plate xi, fig. 2) as consisting of a gland (*a*) and reservoir (*b*) on each side. The glands are elongate-oval, and each has a furrow on the inner side, from the middle

of which the duct arises. The reservoirs are long and club-shaped, having the ducts passing forward from the anterior ends. He describes also the glands of a *Lembothrium* as being composed of twenty small tubes situated upon the salivary duct like the teeth of a comb.

Nitzsch gives several figures showing the salivary glands. In *Menopon mesoleucum* two pairs of glands are shown of which the inner ones are very long and comparatively narrow. They extend in a straight course backwards along the sides of the alimentary canal as far as the rectal glands. In front they become narrowed and pass gradually into the ducts. External to each of these is a shorter gland. This one is also rather elongated and tapers in front and behind. The posterior end is coiled, while the anterior end passes into the duct. Grosse makes the general statement that the salivary organs consist of a salivary gland and a saliva reservoir, and that the latter are filled with a viscous substance.

In the Ischnocera the organs have a more definite shape, being much less variable among the different species. They consist of two pairs of glands and their ducts. Each pair lies on one side of the alimentary canal in the region of the anterior end of the crop and is composed of an outer, generally larger gland, and an inner, smaller one (plate xi, fig. 11, *r* and *g*). In *Trichodectes geomydis* (plate xi, fig. 1) the two are of about the same size. The inner one (*b*) has its long axis transverse and its larger end turned inwardly; while the outer is oval. The outer organ generally has the appearance of being a reservoir rather than a gland. Kramer studied the histology of the two and described the cells of the inner, smaller one as being remarkably distinct, while those of the outer he says are only with

the greatest difficulty made out to be cells. He found the outer organs mostly filled with fat-like drops.

Both Kramer and Grosse describe a second set of salivary glands found only in the Isehnoeera. Kramer described those of *Lipeurus jejunos* as consisting of a group of fourteen cells attached to the smaller of the two glands just described. He could find no ducts connected with them, but, since they were always present and constant in position and arrangement, he still regarded them as having a saliva-secreting function. Grosse observed them in the genera *Nirmus*, *Trichodectes*, and *Lipeurus*. He found, however, that they occurred not only on the crop but also in groups of two, six, and eight, connected with the fat body. On this account, and since he also could discover no duct in connection with them, he concluded that their function as salivary organs was very doubtful.

In *Trichodectes geomydis* there can be no doubt of this glandular nature, for here ducts can be very easily observed. If the alimentary canal be removed from the body and transferred to a glass slide, two sets of large cells may be seen attached to the anterior end of the crop. Each set consists of seven cells, each provided with two large, internal bodies, apparently nuclei. The cells are polygonal and situated close together. By detaching the mass from the crop and floating it out in water it may be seen to be connected by a very distinct duct with the upper end of the neck of the crop, close to where it joins the oesophagus (plate xi, fig. 10, *g*). This is long enough to allow the glands to lie on the upper end of the crop. On passing the glands under a cover-glass the loosely united cells spread apart and there may be seen very clearly a ramification of the main duct passing to each one of them

(plate xi, figs. 3 and 4). It hence appears that in this species these cells form a compound gland of seven cells, each cell being provided with a duct of its own, the ducts of the several cells uniting and finally forming a common duct which opens into the alimentary canal at the mouth of the neck of the crop. In other Ischnoceran genera examined, including *Eurymetopus*, *Docophorus*, and *Goniodes*, these glands are present but the cells in each are more numerous. In *Eurymetopus taurus* (plate xi, fig. 5), each gland is composed of about twenty-four cells arranged mostly in two rows, although in some specimens, at the posterior end, they are three and four rows wide, so that the gland is posteriorly expanded. Each possesses two nuclear-like bodies, (one of these may be a hollow space into which the duct opens, such spaces being present in salivary cells of insects), and they are all closely pressed together so that they assume polygonal shapes. The presence of a duct is much more difficult to determine than in *Trichodectes geomydis*, but by removing the œsophagus and crop to a drop of water on a glass slide, as before, and pushing the glands away from the crop, they may be seen to be connected with the latter by a number of fine fibers. Upon focussing down on these with the microscope, one may be seen larger than the rest, possessing a double-bordered appearance characteristic of ducts when viewed with transmitted light. It is attached to the upper end of the crop at one extremity and at the other to the anterior end of the gland, where it divides close to the latter and becomes lost in the cells. By tearing the cells apart there may be seen attached to and ramifying between them, minute, delicate processes, apparently tubules.

A third set of glands opening into the anterior part

of the alimentary canal are those of the head, already described in connection with the œsophageal sclerite.

With regard to the salivary glands, then, not considering those glands of the head, the two suborders differ as follows: The Amblycera possess simply two pairs of salivary organs—a gland and reservoir on each side of the alimentary canal. These are of variable shape, since they may be simple and relatively small or very large, or they may be compound, consisting of as many as twenty separate, secreting tubules. The Ischnocera possess a pair of simple, small, only slightly variable, salivary organs on each side of the alimentary canal. These are evidently the homologs of the salivary organs of the other suborders, since their ducts unite with one another in the same manner, and since their general position is the same. In addition, they have a pair of small compound glands each element of which consists of a single cell provided with a separate ductule. The species of the Amblycera are specialized individually, those of the Ischnocera as a group.

The Malpighian Tubules.—In all cases known there are four and only four Malpighian tubules. They are simple tubes generally variously dilated near their bases. This dilatation may form a short oval enlargement of the vessels as in *Docophorus lari* (plate xi, fig. 8), or it may be long, and even occupy half the length of the tube as in *Menopon titan* (plate xi, fig. 13). These enlarged parts of the tubes are very variable in size, and according to the specimen may be present and large or entirely absent in the same species. In *Colpocephalum osborni* the basal parts of the two tubes on each side are united for a short distance (plate xi, fig 7). The vessels are generally very much convoluted and form a tangled mass of tubes about the lower part

of the alimentary canal. In others, however, they are straight. In *Menopon titan* they form V-shaped tubes with the bend forward and the inner arm joining the intestines. Each tube consists of an apparently structureless investing membrane (plate xi, fig. 6), of a single layer of large granular epithelium cells within this, and finally of a thin intima lining the epithelium. The lumen is narrow and irregular since the inner ends of the cells are angular, and a convexity on one side of the lumen fits into a concavity of the epithelium on the opposite side.

III. THE RESPIRATORY SYSTEM.

The tracheæ are disposed in two main trunks, one on each side of the body, reaching from the posterior end of the abdomen into the head. Spiracles are situated laterally on the dorsal side of the abdominal segments, and in some species, as *Menopon titan*, there is a spiracle on each side of the prothorax (See Kellogg, 1896). A short branch connects each spiracle with the main longitudinal trunk of the same side. Opposite the union are given off several branches to the various organs of the body. In the head the lateral trunks end by dividing into numerous branches. No dilatation of the tracheæ occurs at any point. In *Menopon titan* a large transverse trunk connects the two lateral trunks in the fourth abdominal segment.

IV. THE NERVOUS SYSTEM.

The nervous system consists of a brain and sub-oesophageal ganglion in the head and a large ganglion in each of the thoracic segments. From the two head

ganglia are given off branches to the mouth-parts and sense-organs. Each thoracic ganglion sends laterally a large branch to the corresponding legs. The last one gives off, in addition to these, branches that go backwards into the abdomen, supplying the organs there situated. In *Eurymetopus taurus* (plate xvi, fig. 7) the brain is large, much wider than long, and consists of two lobes united in the middle line. Each lobe expands greatly laterally. The posterior border of the brain is convex, notched in the middle line. The anterior border is very concave. The brain, therefore, presents from above the appearance of being composed of two large lateral masses connected in the middle line by a narrow commissure. From each anterior outer angle a trunk passes downward and backward to the anterior end of the subœsophageal ganglion. These form the circumœsophageal commissures, and from each a small trunk runs forward to a very large frontal ganglion situated in the median line between the anterior ends of the two cerebral lobes. The subœsophageal ganglion is larger than the brain and is situated in the lower part of the head beneath the œsophagus near the occipital margin. It is somewhat triangular in shape, with one side turned forward.

The brain and subœsophageal ganglion of *Menopontitan* (plate xvi, fig. 8) are very similar to those of *Eurymetopus taurus*. Dorsoventral longitudinal sections show that the brain is rather thick and that the lateral lobes are expanded posteriorly as well as laterally. The circumœsophageal commissures are inclined at an angle of about forty-five degrees. The frontal ganglion is smaller than in *Eurymetopus taurus* and is connected by a short trunk with the upper end of each circumœsophageal commissure. From it a branch runs forward to the labium. The

subœsophageal ganglion is oval in longitudinal sections. The peripheral part of each is composed of rather large cells. Fibers pass from the lower ganglion through the commissures to the outer anterior angles of the brain, where they radiate in all directions to the peripheral cells. Transverse sections of the brain of *Menopon* sp. (plate xii, figs. 1-4, *br*), followed from before backwards, show in front the small, disunited sections which farther back (fig. 1) become enlarged in an inner and ventral direction and connected with the subœsophageal ganglion (*sg*) by two short, straight trunks. The latter ganglion is very flat in front. Back of the commissures (fig. 2) the lobes of the brain enlarge and become ovoid in sections, with the large end turned inward. The subœsophageal ganglion is still flattened and slightly constricted in the middle. Sections passing through the eyes (fig. 3) show a narrow commissure passing over the pharynx connecting the previously separated cerebral lobes which are now oval in shape. The subœsophageal ganglion is still flat but slightly enlarged laterally. Still farther back (fig. 4) the transverse commissure of the brain has increased in thickness, and the subœsophageal ganglion greatly enlarged, especially laterally.

The three thoracic ganglia are large, situated close together, and each is generally larger than the one in front. In *Eurymetopus taurus* each ganglion is hexagonal viewed dorsoventrally (plate xvi, fig. 7), with two sides transverse, one in front and the other behind. The most posterior ganglion is large and joined to the mesothoracic ganglion by its anterior side. From the lateral angles, which are a little back of the middle, large trunks are given off to the legs, and from the posterior angles larger branches, one on each side, go backwards

into the abdomen. The mesothoracic ganglion is smaller than the last one, but, except that the lateral edges are more nearly equal, is very similar to it. Its anterior side joins the posterior side of the one in front, and from its lateral angles trunks arise that supply the mesothoracic legs. The prothoracic ganglion is more elongated than the others and the lateral angles are relatively farther back, but as before, the leg branches arise from them. There are no interganglionic commissures between the thoracic ganglia but the prothoracic ganglion is connected with the subœsophageal ganglion by two short, longitudinal trunks. In other forms the thoracic ganglia are a little more separated, but in all cases known, the nervous system is much concentrated and ganglia never occur in the abdomen. Longitudinal sections of *Menopon titan* (plate x, fig. 1) show that the thoracic ganglia (g_1 , g_2 , and g_3) are oval longitudinally and have an outer layer of large cells like those in the head. Transverse sections of *Menopon* sp. (plate xii, figs. 5-7) show that each ganglion (g_1 and g_2) is double and very large. In *Eurymetopus taurus* (plate xvi, fig. 7) each ganglion is supplied with tracheæ from a large, transverse commissure (tr) passing transversely from one main, lateral, tracheal trunk to the other. Each of these transverse trunks is applied very closely to the posterior part of the corresponding ganglion, and gives off into the latter numerous ramifying branches.

V. THE DORSAL VESSEL.

The heart was first described by Wedl in 1855. Nitzsch says nothing about it. Kramer in 1869, briefly described that of *Lipeurus jejunos*. Grosse

adds little to the descriptions given by Wedl and Kramer. Wedl found that it could be studied successfully only in living animals. According to him the heart proper of *Menopon pallidum* is one-chambered and is situated in the next to the last abdominal segment just below the dorsal wall. The inner cavity is provided in front and behind with an opening. It consists of a molecular parenchymous part on each side, and a median membranous part. From the lateral, thickened part there arise ragged prolongations reminding one of the papillary muscles of the vertebrate heart, and which terminate in fine thread-like fibers attached to the median membranous walls of the heart. To the outer side of the parenchymous part are attached on each side a bundle of tense fibers, which may be termed the right and left suspensory fibers of the heart. The dorsal aorta has a swelling at its base forming a bulbus arteriosus. This has on each side a bundle of fibers, the right and left suspensory fibers of the bulbus arteriosus. Likewise at the opposite end of the heart is a swelling forming the bulbus venosus. This has two prolongations at its posterior end which appear to be inlet tubes allowing the entrance of the blood into the bulbus venosus. At the posterior end is a median row of fibers.

Kramer describes the heart of *Lipeurus jejunus* as a long narrow tube enlarged at its posterior end. Here are attached the very much reduced wing-muscles. Wedl does not mention these but very probably refers to them when he describes the "suspensory fibers". At the posterior end, according to Kramer, are four openings to admit the blood. Wedl states that the heart-beats amount to 112-120 per minute in specimens just taken from the living host, but sink to 56-52 in specimens taken from a host that has been dead a day or so.

He further describes the manner in which the different parts of the heart and aorta contract, and also gives an account of the methods he used in making his observations. Finally he states that he examined several representatives of the Philopteridæ, such as *Lipeurus variabilis*, *Goniodes colchici*, and *Docophorus atratus*, but apparently he determined merely that the heart is present in these forms.

VI. THE REPRODUCTIVE ORGANS.

The reproductive organs of both the male and the female may be divided ontogenetically into (1) parts derived from the interior of the body, including the testes or ovaries, the vasa deferentia or oviducts, and the vesicula seminalis, ejaculatory duct or vagina and spermathæca; and (2) into parts derived from the exterior of the body, including a genital cavity in both sexes, and an eversible penis with variously developed accessory chitinous parts in the male. According to Nusbaum (1882) the embryological origin of the internal organs of *Lipeurus bacillus* and *Goniocotes hologaster* is as follows: The parts arise from four fundaments. Two of these are derived from the mesoderm and give rise to the testes or ovaries and the vasa deferentia or oviducts; the others are derived from the epiblast of the ventral side of the fourth abdominal segment, and give rise to the vesicula seminalis and ductus ejaculatorius of the male or the vagina and spermathæca of the female. The second pair subsequently unite forming the unpaired organs of the adult. The latter are hence strictly external since they originate from the epiblast of the embryo. For convenience of description, however, the parts are classified better as internal and

external genitalia, in which the terms *internal* and *external* are used relatively with regard to the adult structure.

1. THE MALE ORGANS.

The Internal Male Genitalia.—The testes are either six or four in number in adults, the former number being confined to the Amblycera and the latter to the Ischnocera. In the Amblycera they are variously-shaped organs lying in the lateral parts of the abdominal cavity, three on each side, one in front of the other. Each opens by a short vas deferens into a common sperm duct. In the Ischnocera the testes are two in number on each side. They are generally pyriform, having the pointed ends turned away from each other and each terminated by one or two fine threads, and having the blunt ends approximated and connected by a short, narrow commissure from which the common vas deferens arises. The other internal reproductive organs of the male are essentially alike in the two suborders. The vas deferens on each side runs generally first backward from the testis and then turns forward to enter the sperm vesicle. The latter organ is usually single, but is composed of right and left lobes which in many cases are easily separated and which are sometimes normally disconnected. In all cases their lower ends open into a common ejaculatory duct. This goes to the exterior and may be either straight or variously bent. The two halves of the sperm vesicle when not entirely separated externally are essentially distinct, since each half possesses its own lumen, into which the vas deferens of the same side opens. Figure 4, then, may be taken to represent diagrammatically the typical condition of the internal male genitalia of the whole order. The figure as it is

represents more exactly the Amblyceran structure, but the Ischnoceran may be produced from it by suppressing one testis on each side and drawing the other two toward each other while their distal ends are turned in opposite directions. Nusbaum states that in *Lipeurus bacillus* and in *Goniocotes hologaster*, two Ischnoceran species, the fundamentals of the testes in the embryos form each three lobes, of which the posterior two develop into testes, while the anterior one atrophies. This anterior lobe, if it represents a third testis, establishes three on each side as the typical number of testes in the whole order.

In *Physostomum diffusum* (plate xiii, fig. 9) the testes are rather small. The most anterior is situated relatively rather far in front of the others, and is triangular in outline, having the base turned forward. Its posterior end becomes rather gradually narrowed, passing into the vas deferens. The middle and posterior testes are enlarged toward their bases and pointed at their distal ends. Each is connected with the vas deferens by a short vas efferens. The sperm duct runs a short distance back of the last testis and then turns forward to the seminal vesicle. This organ lies in the third abdominal segment. It is rather small, being about the length of the segment in which it is situated.

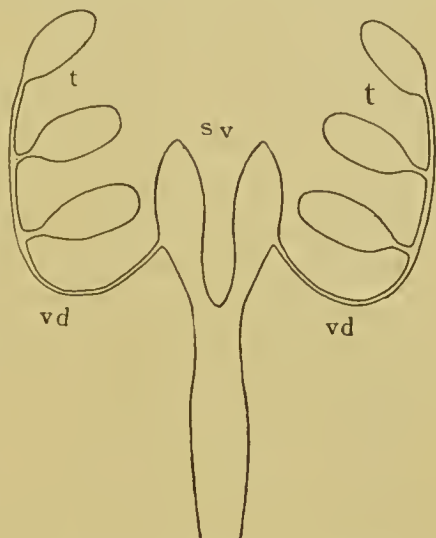


Fig. 4.—Diagram of the internal reproductive organs of the male Mallophaga; *t*, testes; *vd*, vasa deferentia; *sv*, vesicula seminalis.

It is bilobed, being divided by median dorsal and ventral furrows into a right and left half. Each half is again partially divided by a longitudinal furrow into two secondary lobes, the outer of which is thinner than the other. From the posterior end of the vesicle a wide, almost straight ejaculatory duct passes to the exterior. Its lower half is provided with a strong, transverse musculature. The vasa deferentia appear to open into the ejaculatory duct at a point above its middle. They, however, merely become attached to this duct here, since they run forward along its sides, closely bound to it, and enter the sperm vesicle.

The vesicula seminalis of *Trinoton luridum* is elongated antero-posteriorly, tapers anteriorly, and is enlarged and rounded posteriorly. From it the ejaculatory duct runs forward and to the left. Soon it makes an abrupt bend backward and toward the middle line again, where it enters a greatly enlarged and very muscular division which opens to the exterior.

The whole reproductive system of *Menopon titan* is very greatly modified by an extreme complication of the different parts. They are all essentially the same, however, as in other species, and the modification is mostly confined to the parts developed from the exterior and to the muscles attached to these parts. These will be described farther on. The main modification of the inner organs is a great increase in the length of the ductus ejaculatorius. The testes (plate xiii, fig. 10, *t*) are oval, elongated tubes situated along the sides of the body. The most anterior on each side is connected with the anterior end of the vas deferens of the same side. The second and third are connected with the same duct at points farther back by rather long vasa efferentia. The part of the vas deferens between the first

and second testes (beginning with the one in front) is longer than that between the second and third. The anterior end of each testis reaches some distance anterior to the posterior end of the one in front. Each vas deferens proceeds a short distance back of the last testis and then turns toward the median line of the body, the two are here connected by a transverse duct (*c d*) and enter the large mass of muscles surrounding the invaginated penis (this structure together with the muscles will be described under the head of the External Genitalia; see *postea*). They pass between the fibers and enter the cavity surrounded by them; turning then forward they run in this direction along the upper part of the cavity to the anterior end of the latter. Here they emerge from the muscles and go forward to the vesicula seminalis (*sv*), each entering the side of this organ toward the set of testes with which it is in connection.

The seminal vesicle is very large, composed of two only slightly united lobes. It is elongated antero-posteriorly, tapering at both ends, and connected with the ductus ejaculatorius at its posterior ends. The latter is, as stated, a very long tube, and is consequently very much coiled. It begins at the posterior completely united end of the vesicula seminalis as a rather wide tube. It runs backwards from here only a short distance and then makes a turn toward the median line, the seminal vesicle being situated a little to the left. Here it makes a small loop upon itself and then runs forward to near the anterior end of the seminal vesicle, which reaches forward into the metathorax, making during this course a second loop upon itself. At the anterior end of the vesicula it makes a sharp bend backward, dorsal to the vesicula, and runs in a straight

line to its posterior end, where it becomes narrower and turns toward the middle line. It reaches the transverse muscles of the penis and becomes here thrown into several loops, and then runs forward among the longitudinal muscles of the penis to the anterior end of the innermost (*int*) tube of the latter, with which it becomes continuous.

Nitzsch does not describe extensively the reproductive organs, merely giving a general description of them for the different suborders. He figures, however, the male organs of *Colpocephalum flavescens* and of *Menopon pallidum*. In the former (plate xiii, fig. 7) the six testes (*t*) are pear-shaped, situated with their broad ends upon the vasa deferentia (*vd*), with which they are connected by very short secondary ducts. Their pointed ends are terminated each by a short fiber. The vasa deferentia run backward and inward, uniting with the basal portion of the ductus ejaculatorius (*ej*) far from the vesicula seminalis (*sv*). The latter is somewhat elongated divided longitudinally to near its base by a median and two lateral grooves. The ejaculatory duct is very long. Immediately after leaving the vesicula seminalis it turns forward lateral of this organ and runs forward to some distance beyond its anterior end; the duct then turns backward and slightly inward, ending in a somewhat enlarged basal part to which is attached an internal chitin rod (*r*). In this form and in *Physostomum diffusum* the ductus ejaculatorius is very wide compared with this duct in *Menopon titan* and *Menopon pallidum*. In *Physostomum* it is provided with very prominent transverse muscle fibers.

In *Menopon pallidum*, as figured by Nitzsch, the testes are small, oval, and connected with the vasa deferentia by rather long ducts. The vasa deferentia are much

convoluted in the portion lying between the testes and their proximal ends. The vesicula seminalis is expanded and four-lobed at its distal end, two lobes being situated on each side of the median line. From each of the two inner lobes a short twisted blind tube runs forward. The posterior end is rather pointed and passes into the ejaculatory duct. This duct is long and narrow, and is thrown into numerous convolutions, which, however, all lie between the vesicula seminalis and the external genital opening. The vasa deferentia open into the base of the ductus ejaculatorius.

The following are examples of the male organs of the Ischnocera. In *Eurymetopus taurus* (plate xiii, fig. 8) the testes (*t*) are four in number, two on each side. Each is a small pear-shaped organ having the tapering end terminated by a fine thread. The two on each side are closely connected by a rather wide commissure. They lie in the lateral part of the body cavity in the third and fourth abdominal segments close to the dorsal wall, with their long axes in an antero-posterior direction. From the inner side of the commissure connecting the testicles the vas deferens (*vd*) arises. It is a narrow tube passing first backward and inward and then forward and inward till it reaches the seminal vesicle (*sv*). Each duct enters the base of this organ on its own side. The vesicula is much the same as in *Physostomum* and *Colpocephalum*, it being partially divided into a right and left lobe by a median furrow. Each half is then again divided by median dorsal and ventral furrows on its surface. The two middle lobes of the four thus produced project farther forward than the lateral ones. Near the posterior end of the organ the four furrows cease and the ductus ejaculatorius (*ej*) takes its origin from a very short, undivided portion.

The ductus is separated from the vesicula by a constriction just in front of which the vasa deferentia terminate. The ejaculatory duct is divided into a wide, anteriorly and outwardly running, proximal part, and a narrower, longer, and posteriorly running, distal part. The two meet in front at an acute angle. The proximal dilated part is well provided with transverse circular muscles; the distal portion is also provided with muscles but not so prominently as the other. The ductus opens into the penis, but this will be described under the next heading.

The testes (*t*) of *Goniodes cervinicornis* (plate xiii, fig. 3) are rather more elongated than those of the last species described, but otherwise very similar. Their larger ends are approximated, and connected by a commissure narrower and longer than in *Eurymetopus*. The vasa deferentia (*vd*) are simple tubes passing from the commissure backwards and then forwards to the seminal vesicle (*sv*). They enter the latter, however, far up, almost at the midlateral points. In this form the vesicle is completely divided to its base into a right and a left lobe. Each lobe is elongated, tapering in front and behind. It is enlarged in its anterior half, and joined a little below its middle point by the vas deferens of the same side. The two lobes are connected with the upper end of the ductus ejaculatorius, whose lumen is formed by the union of the cavities of the seminal vesicle. A short, backward-running, proximal part of the ductus is comparatively very narrow. It soon, however, enters on the right a greatly enlarged division of the duct, which extends anteriorly and to the right of the vesicula. It is longer than the latter, wide through the middle, and narrowed at each end. Anteriorly it gradually contracts into the comparatively

narrow, backward-running part of the duct. This proceeds to the penis, and in its course makes a bend to the left back of the seminal vesicle, then, after reaching the middle line of the body, goes straight to the exterior. The upper enlarged part of the duct is strongly muscular.

Nitzsch figures the male organs of two Ischnoceran species, *Goniocotes compar* and *Lipeurus jejunus*. In the former the pear-shaped testes abut closely upon each other by their large ends, and from between them the vas deferens passes by a convoluted course to the upper end of a posterior enlarged part of the ejaculatory duct. The latter is long and rather slender for most of its length. It makes a large bend forward as in the other species described, the inner arm of the loop likewise is considerably dilated, but a narrow neck intervenes between this part and the vesicula. The latter is partially divided anteriorly into two lobes.

Kramer (1869) describes very fully the male reproductive organs of *Lipeurus jejunus*. According to him the two testes on each side are acorn-shaped, having their pointed ends terminating in a fine-branched fiber. They are formed by a continuation of the outer homogeneous covering of the testes. Just where they leave the testes they contain three or four nucleated cells beyond which they become solid threads. Each divides into two main branches which are attached to the dorsal tube, but also by side branches to the Malpighian vessels and to other organs, so that they are simply members of the connective fibers that bind all the organs together. The slender vas deferens arises from the united larger ends of the testes. It consists of an outer structureless covering and an inner cellular epithelium. He describes the vesicula seminalis as an

accessory secreting gland, stating that the vasa deferentia enter it and continue through it as an integral part, and then pass out as its duct forming the ductus ejaculatorius. Exception to this view will be taken farther on. According to Kramer the vesicula consists of a rather long duct and of the gland proper, the former widening itself suddenly into the latter. The walls of the duct are composed of several superimposed parts; surrounding all is a loose mass of fibers which are partly nerves and partly connective threads. Within this is a fine structureless coat only here and there provided with distinct nuclei, which is continuous over the whole gland. Below this is a thick coat of cells in several layers. Lining the duct is a two-layered intima; where the duct passes into the gland the two layers diverge, the outer passing over the outside of the gland just beneath the outermost structureless membrane of the duct, which, as stated, passes over the whole gland also, and the inner continuing into the cavities of the gland as their intima. The cells of the cellular layer of the duct are contractile and appear to be muscle-cells corresponding with the muscular cells of the œsophagus and crop. At the lower end of the gland the vasa deferentia penetrate the two outer membranes and run forward beneath a series of wide cell-like plates, with which, however, they do not unite. They proceed forward thus, surrounded by the plates as by a sheath, along the middle of the flat surface of the gland to near its upper end, where they first enter its interior and then within traverse again its whole length. Within the gland they are surrounded by its secreting cells; at its lower end they unite to form the ductus ejaculatorius. It is to be noted that the muscle-cell layer of the duct continues for only a short distance

over the base of the gland, the latter being situated within the cells as a flower in its calyx. Kramer further describes the penis and its muscles, and also the origin of the sperm and formation of the spermatophores.

Transverse sections through the testes of *Menopontitan* show that each is surrounded by a structureless outer tunica. Within this is an epithelium of high narrow cells projecting irregularly with ragged edges into the lumen of the organ. They are all more or less curved and together present somewhat the appearance of an iris diaphragm (plate xiii, fig. 1). An intima is apparently absent. The lumen of the testes is not very large and is filled, in prepared specimens, with a granular substance which is probably a coagulated fluid. The vasa deferentia have an outer tunica resembling that of the testes, within this a single-layered cellular epithelium. The cells are much smaller and relatively a great deal shorter than those of the testes (plate xiii, fig. 2). The lumen is small and lined by a thin structureless intima covering the inner ends of the epithelium cells. The seminal vesicle is composed of the same elements as the vasa deferentia. The epithelium cells are columnar but comparatively short (plate xiii, figs. 5 and 6). The lumen on the other hand is very large and filled with an apparently coagulated (in mounted specimens) non-cellular substance. The organ in sections is clearly seen to be a double structure, for the two halves are almost entirely separate. The two cavities communicate only through the upper end of the ejaculatory duct. The main connection between the two lobes is by an apparently outer layer of the tunica, which in the groove between the two sides passes across from one to the other, and an inner layer continuing around its respective lobe. In some places,

however, in the basal half of the organ, the inner layers of the tunicas are absent and the opposing cells fused. The ejaculatory duct (plate xiii, fig. 4) has the same structure as the seminal vesicle and vasa deferentia. Outside of its tunica, however, is a layer of circular muscle fibers. These continue a short distance over the base of the seminal vesicle (plate xiii, fig. 5) and unite the lower ends of its lobes more firmly, but they soon cease.

From the preceding descriptions it is evident that figure 4, on page 177, represents the typical development of the internal genital organs of the males for the whole order. The only constant difference between the two orders in respect to these organs is the number and relative position of the testes. The latter organs have no constant form in the Amblycera although the variation is small, while on the other hand, in the Ischnocera the form is almost entirely constant. Thus, with respect to the sperm glands, as was found to be the case also with the salivary glands, the Ischnocera are specialized as a group, while the Amblycera are specialized among themselves on a less evolved type.

It now remains to consider the nature of the structure referred to as the vesicula seminalis. As stated, Kramer regarded it as an accessory gland, but he did not show what its function as a gland is. He found, further, that the spermatophores are not formed in the male ducts, but in the female spermathæca. That it is composed of united right and left organs is very evident. This is indicated by the fact that it is actually entirely divided into two lateral lobes in at least one form, and in others it is more or less deeply cleft, while in none known is it without a median groove. Further, according to Nusbaum (1882), it actually

arises from two separated fundaments in the embryo, which subsequently unite. Kramer states that since the secreting cells are arranged around two tubes, the vasa deferentia, the organ has the appearance of being composed of two closely united glands, and that a separating wall is actually present. Grosse (1885) disagrees with Kramer and regards the structure as consisting of two bladder-like enlargements of the ductus ejaculatorius, which serve to retain the spermatozoa as they come from the testes until sent to the exterior by the contraction of the vesicle. According to him, accumulations of spermatozoa are to be found in the upper part of the organ. He states also that a secreting power cannot be denied to the cells forming the wall. The walls are thick and have a glandular appearance, but, other than this, proof of their secreting function appears to be absent.

The embryological investigations of Nusbaum, if correct, show clearly the relation of the vesicula seminalis to the adjacent parts. As has been shown, the vesicula generally presents a four-lobed appearance, being divided by three longitudinal constrictions of which the median one is the most constant and the best marked. According to Nusbaum the vasa deferentia unite with the fundaments of the reproductive organs derived from the epiblast. The latter then become each produced into two lobes at their anterior ends before they fuse with each other. Then, when they unite, there is produced a structure having a four-lobed anterior end to which the vasa deferentia are attached, and an undivided posterior part. The former becomes the vesicula seminalis and the latter by elongation the ductus ejaculatorius.

The External Male Genitalia.—The outer accessory structures connected with the inner reproductive organs have never been very carefully studied. Nitzsch (1818), Piaget (1880, 1885), and Taschenberg (1882) described them mostly as they appeared through the body-wall. Piaget made a few dissections. The external organs consist of two parts: (1) a simple or compound invagination of the body-wall of the last abdominal segment, and (2) chitinous parts developed in the walls of the invagination. In addition, however, there are muscles attached to these parts, situated within the body, and which are very important and sometimes very complicated adjuncts of the copulatory organs. The following descriptions represent all the genera of which males could be obtained.

Eurymetopus taurus (Plate XIV, fig. 5, plate XV, fig. 1).

The male has nine abdominal segments. The last tergum is very much narrowed from side to side, forming a triangular terminal dorsal plate with the apex, which is a little invaginated, projecting backwards. The sternum of the last segment, on the other hand, is much enlarged, projecting much beyond the corresponding tergum both posteriorly and laterally as a large plate with slightly upcurved lateral edges. Above this plate the top of the copulatory organ may be seen projecting a little beyond the end of the tergum. By separating these two plates a terminal cavity of the abdomen is exposed, having the chitinous penis lying along the middle line of its floor, and the anus opening into the upper posterior part. This space will be spoken of as the *genital cavity*, since it is evidently formed to accommodate the reproductive function, and since it contains the external part of the copulatory

organ. The opening of the alimentary canal into it is apparently a secondary result, since the anus is terminal and exposed in the female when the genital cavity is in front of the last sternum.

Longitudinal sections through the male show that the genital cavity is formed by a wide invagination of the hind end of the abdomen (plate xv, fig. 1). The cavity is almost as wide as the body itself, and extends from the posterior border of the last segment far into the eighth. In its upper wall near the posterior margin is the anal opening (*a*). From its inner end an evagination of much smaller diameter than the primary invagination takes place, forming a long, rather slender, distally tapering tube in whose walls a thick deposit of chitin is present. This is the penis (*p*). From its base a large, wide chitinous plate extends forward *within* the body-cavity (*pl*). The part of the penis lying within the genital cavity will be spoken of as the *external* part of the penis, and the plate extending forward within the body cavity as the *internal* part. It is to be noted, however, that the plate is strictly external, since it is simply a part of the chitinous covering of the body, and that it is internal only in the sense that an inward-running process of the body-wall is internal. The genital chamber reaches much farther forward below the penis than above it. At the point where the internal and external parts of the penis are continuous, the ductus ejaculatorius (*ej*) enters into the evagination of which the outer part is formed, and opens by a terminal orifice to the exterior. The internal plate extends forward beneath the ductus ejaculatorius and close to the ventral wall of the body to the anterior border of the second abdominal segment. To it the muscles (*em*) of the penis are attached.

The penis (plate xiv, fig. 5) as a whole is a dorsoventrally flattened structure. Its anterior three-fourths is wide, forming the internal plate, while the posterior one-fourth is wide at its base but rapidly tapers beyond this. The posterior fourth is the external part formed by the chitinous thickening of the evagination described. Where the two meet, a large, square area is taken out of the penis. The margins at the side of and behind this are very thick. From the former arise two wide processes, one on each side, which rapidly contract and curve dorsally and inwards, almost meeting each other in the middle line. In front of these, two other processes arise from the anterior margin of the non-chitinated space, as two backward prolongations from the inner edges of the thickened lateral margins of the plate in front. They extend backward, outward, and slightly ventrally, terminating beyond the posterior edges of the lateral processes, and almost reaching across the unchitinated space. They are narrower than the lateral processes and taper but slightly. From the posterior thickened margin of the unchitinated area a third pair of processes arises. These are short, rapidly tapering, and continuous with the ventral edge of the transverse part behind the unchitinated area, this part being, as before stated, tubular. These processes lie close together, each just to one side of the median line. Their inner edges are slightly divergent and their outer edges strongly convergent and concave. Their tips reach about as far forward as the posterior ends of the processes in front. There are thus six processes—two in front, two behind, and one on each side—arching over the unchitinated space of the chitinous penis. They surround the terminal portion of the ejaculatory duct, since the latter passes beneath the arch formed by the dorsal processes on its way to the external tubular

part of the penis. The several processes serve, however, partly for the attachment of muscles. The anterior half of the internal plate is comparatively very thin and tapers to a blunt termination in front. Back of the middle, also, the plate contracts somewhat toward its base. The external penis has a large, thick, basal part, which rapidly contracts to a slender, tubular, distal part, terminating by an arrowhead-shaped enlargement, the posterior angles of which are very sharp. This terminal tube curves downward a little toward its tip (plate xv, fig. 1), where its inner cavity opens to the exterior.

To the anterior end of the chitinous penis on its ventral side are attached two wide sets of muscle fibers. These pass backward, outward, and a little ventrally to the ventral wall of the abdomen. Each set is parallel-sided and arises from the penis just to one side of the middle line, and as the two diverge backwards they form only a very small angle with each other. To the other end of the penis are attached four sets of muscles, two dorsal and one on each side. Each lateral bundle is attached to one side of the enlarged subterminal part of the penis. It passes forward and outward, forming an angle of about 45° with the penis, to the lateral wall of the body-cavity. The dorsal muscles are near the middle line, and extend anteriorly, outward, and dorsally. These posterior sets are shorter than the anterior ones, ending on the body walls in the fourth and fifth segments.

The mechanism of the chitinous parts, invaginated tube, and muscles is self-apparent. The anterior muscles contracting push the chitinous penis backward, and it carries outward the partly evaginated inner tube of the genital cavity, the flexible walls of which become

erected. In this way the external part of the penis can be protruded from the genital cavity, which during the operation becomes itself more or less erected. The posterior sets of muscles contracting reverse these movements, resulting in a withdrawal of the penis into the genital chamber.

Docophorus lari (Plate XIV, fig. 8).

The chitinous genitalia in this species consist of a large, thin, flat chitinous plate situated within the abdomen close to the ventral wall, and an external, conical tube with two articulated lateral arms. The plate is rather short, being less than twice as long as wide. Its greatest breadth is near its posterior end; it tapers somewhat forward but has a wide rounded anterior termination. The external part is tubular and represents an inner tube evaginated from the anterior end of the genital cavity. Its walls are very thick and entirely chitinous. In general shape it is, as stated, conical, having the internal plate passing forward from the ventral part of the anterior end. Its lateral outlines are slightly convex. Posteriorly it terminates in a slender median prolongation, at the extremity of which is the external genital opening. Into the anterior end of this part, dorsal to the internal plate, the ductus ejaculatorius enters. Five processes surround the slender, parallel-sided terminal tube. Two of them are dorsal, two lateral—one on each side, and one ventral. The latter is triangular in shape, rather elongated antero-posteriorly, and has the more pointed apex pointed backwards in the median line. The dorsal processes are much longer than the ventral one. Each is a flat plate reaching almost to the posterior end of the central tube. It expands toward its middle and then tapers off again

beyond this point. The approximated edges are straight and lie each just to one side of the middle line, while the outer edges are very angularly convex. The lateral processes are short and thick, somewhat hook-shaped, with the ends turned outward. They reach a little beyond the ventral plate.

Two long curved rods are attached externally to the lateral aspects of the base of the outer part of the penis. Their anterior ends, by which they are movably articulated, are considerably enlarged. Each is curved throughout its length, so that the outer margin is convex and the tips, which extend a little farther backward than the median parts, converge. The part of the penis between these processes is very strongly chitinous. The lateral margins of the internal plate are much more strongly chitinated than the median part, so that in a cleared and mounted specimen the former alone show through the body wall. Consequently there is the appearance of an internal pair of rods extending forward from the bases of the external pair; and in many of the figures of Nitzsch, Piaget, and Taschenberg the chitinous genitalia of the males are represented as if this were the case. The plates serve, as in *Eurymetopus taurus*, for the attachment of muscles. One specimen was found with the penis protruded. The lateral external rods were turned forward, over the back of the insect, so that the median conical part was left projecting backward and upward alone. It is not very clear what the function of the rods is, since there are numerous forms, as will be shown, in which they are absent. The turned-forward position is probably not abnormal, since they were found thus in several specimens of other species, and some of the drawings of Piaget show them the same. They have the appearance

of acting as a guard to the penis, or they may also serve as levers to prevent the latter from being pushed back into the genital cavity. The penis, however, is otherwise very much the same as in those forms where movable rods are absent.

Nirmus pacificus.

The penis is very similar to that of *Docophorus lari*. The internal part is a wide plate which tapers slightly forward and ends anteriorly with a wide rounded outline. The proximal half of each lateral margin is slightly convex and very thickly chitinized, so that the two give the appearance of a pair of curved prongs reaching forward into the body cavity, since the median part of the plate is comparatively very thin and transparent. Between the internal plate and the outer parts is a thickened portion common to both. The external penis consists of two lateral curved rods articulated to the base of the median external part. When the penis is retracted within the genital chamber, these two rods extend backward with their tips approximated and their concave edges turned toward each other. When, however, the penis is protruded, the rods turn forward over the back of the insect and become rotated outwards, so that their convex edges are toward each other and their tips divergent. The median external part is prolonged terminally into a slender, tapering, chitinous tube, which appears to bear at its end the genital opening. Surrounding this are five processes which arise near its base and are much the same as those of *Docophorus lari*. On the dorsal side is a pair of rather long slender plates, on the ventral side a slender median rod, and on each side a rather large, outward-turned process reaching a little beyond the extremity of

the ventral rod. Ventrad of these last are two small cusps. The dorsal laminae are much longer than the others, but the central tube projects a little beyond them. The last abdominal sternum is a wide, rounded plate which projects backwards so as to lie beneath the penis when this organ is protruded.

Giebelia mirabilis. (Plate XIV, fig. 4).

In this species the penis consists of the same parts as the two last described, there being present an internal plate, an external conical median part, and two lateral processes. The plate is wide and comparatively very short, its length being only a little greater than its breadth. It lies within the body close to the ventral wall, and to its dorsal surface muscles are attached. The sides are a little concave, its anterior border straight with corners rounded. The lateral basal parts are thicker than the rest. The external intromittent part of the penis is short, wide, with convex lateral edges, rapidly contracting distally, and ending in the middle line with a short, narrower prolongation. This is not entirely chitinized as in the other forms described for its distal half is almost membranous. At the base of the internal plate on its dorsal side the ductus ejaculatorius enters the external penis. The two lateral processes are short and thick, each being only a little longer than half the internal plate. They are curved, having the convex edges turned outward. They converge posteriorly but the tips are turned straight backwards forming an angle with the rest, so that the terminal parts lie parallel with each other. Their bases are enlarged and movably articulated to the rest of the penis as in the other forms described. The articulation is the same as that

between the segments of the body and the joints of the legs; i. e., the parts are continuous but non-chitinized where the articulation occurs.

Goniodes cervinicornis. (Plate XIV, fig. 2).

The penis can be protruded for a distance about equal to three segments of the abdomen. The outer part consists of a delicate membranous tube evaginated from the inner end of the genital chamber. It is protected by three chitinous processes arising from a circular chitinization surrounding the base of the membranous penis. Two of the processes are lateral, long, slender, tapering, and somewhat convergent, with the outer edges convex and the inner concave. The third is ventral and median. It is a narrow chitinous rod having the distal end triangularly expanded, terminating some distance in front of the posterior ends of the lateral processes. These parts are free from the wall of the membranous penis but closely surround it. Lying within the dorsal wall of the latter is a thin, wide, chitinous plate arising also from the circular chitinous base of the penis. It is shorter than the ventral process, and has its edges a little concave. From the anterior ventral margin of the basal part of the external penis a large, thin, parallel-sided, chitinous plate, having a rounded anterior edge and slightly concave lateral edges, arises and passes forward within the body-cavity, giving attachment to protractor and retractor muscles. It lies close to the ventral wall of the body-cavity, and at its base the ejaculatory duct enters the external penis. The opening into the latter is overhung by a wide tapering plate. The membranous penis extends beyond the ends of all the chitinous parts. When the chitinous structure is pushed outwards the outer processes

and the common chitinous base are entirely exposed. It is to be noted that in this species the lateral processes of the external penis are not, as in *Docophorus*, *Nirmus*, and *Giebelia*, movably articulated to the base, and also that the median part is much less extensively chitinized.

***Lipeurus fuliginosus major*. (Plate XIV, fig. 1).**

In this species the chitinous genital parts form a fork-shaped structure. A long, narrow plate lies within the body, representing the handle, while the external part consists of two prongs. The internal plate is comparatively much narrower than in any of the species so far described. It is a little contracted from side to side toward its base. Distally it gradually tapers to a blunt termination. Its posterior end expands suddenly and becomes bifid. Each arm is very short and extends backwards and outward, forming an angle of about 45° with the plate. The posterior borders of the two form a concavely rounded edge to their end of the plate. Attached to the posterior end of each of these prongs is a lengthened knife-like piece which extends backwards into the genital cavity. The two are dissimilar. The one on the left is larger, being both longer and wider, but they differ in still other respects. The left one has its outer edge convex proximally and concave distally; the inner edge of the same shows similar curves but in opposite order. The end tapers down to a point directed somewhat outwards. The outer edge of the right smaller prong has an outline corresponding with that of the inner edge of the left prong. That is, it is concave toward its base and convex toward its tip. The inner edge is convex at the middle, decidedly concave proximally and slightly so distally. Hence its point is

turned inward—relatively opposite to that of the left prong.

The bifid posterior end of the internal plate is imbedded in the base of the chitinous penis. The outer prongs are attached to the arms of the bifurcation in a manner much different from that in other forms. The base of each prong is a little expanded and bears two tapering processes projecting inwardly and anteriorly, one lying dorsal to the other. The dorsal process is the larger; it is curved so that the posterior margin is concave and the anterior convex. The tips of the dorsal processes of the two sides are directed toward and lie close to each other. Each is connected by a delicate dorsoventrally flattened chitinous bar, which passes outward to the arm on the same side of the bifid base of the internal plate, and fuses with it very near its posterior ends. The ventral process is smaller than the dorsal one; its posterior edge is convex and its anterior edge concave. The end of each arm of the plate abuts upon the corresponding prong between the bases of the two processes of the latter, the transverse slender bar of chitin serving to connect the two otherwise separated parts. Lying in the dorsal wall of the membranous penis is a thin chitinous plate. It extends from near the bases of the lateral prongs to a short distance from the distal end of the smaller one. It also is symmetrical. The right edge is about straight and distinctly marked; it lies nearer the side of the penis than does the left edge, so that the plate is not median. The left edge is much less sharply defined and extends obliquely from the left side of the base of the penis posteriorly and toward the middle line. To the dorsal side of the internal plate is attached a large mass of muscle fibers, and on the same side of the plate the ductus ejaculatorius enters the penis.

Oncophorus bisetosus californicus.

There is nothing in the genitalia of this form different from those already described. The chitinous parts consist of a rather wide internal plate with thickened margins and transparent central part, and of an outer median tapering chitinous intromittent organ with articulated lateral processes. Piaget figures *Oncophorus unguiculatus* in which the genitalia are apparently the same as in the form just described.

Goniocotes creber. (Plate XIV, fig. 9).

In this form the chitinous genitalia are extremely reduced. Within the body is a long narrow plate reaching almost to the anterior end of the abdomen. It is very thin and transparent except laterally, where it is weakly chitinized, giving the appearance of two long, very delicate, slightly curved rods lying within the body. Each of these is continuous externally in the wall of the penis. Their outer parts are more chitinized, the tips sharp and convergent. Muscles are attached to the internal part. Piaget figures several species of *Goniocotes* in which the chitinous genital parts are about the same as in *G. creber*, consisting of an internal plate with external prongs. In some the plate is evidently more chitinized than in this form.

The species whose genitalia have been described are all Ischnoceran forms; the following belong to the Amblycera and it will be seen that the genitalia are more simple than in the others, though essentially the same.

Trinoton luridum. (Plate XIV, fig. 7).

A genital chamber is present with a membranous penis arising from its inner end. The chitinous parts consist of a long, slender, tapering rod running forward

within the body cavity from the base of the penis. Its posterior end is expanded and bifid, the prongs being external and imbedded in the wall of the penis. They extend posteriorly and a little outwards, each being a little longer than half the length of the internal rod. Each prong ends bluntly posteriorly, but some distance in front of its posterior end it gives off a process wide at its base but soon narrowing very much, which runs dorsally a short distance and then turns posteriorly, extending in this direction parallel with the main prong from which it arises past the posterior end of the latter, and then turns inward to meet and fuse with the corresponding process of the other side. This median part is very weakly chitinized. The arc thus formed lies in the dorsal wall of the membranous penis, while the two prongs are lateral. The penis extends some distance beyond all the chitinous parts. The ductus ejaculatorius enters it above the internal rod, which latter serves for the attachment of muscles. The intermittent organ in this form, then, consists of a membranous tube evaginated from the inner end of the genital chamber, in whose walls chitinous rods are developed which unite anteriorly to the ventral wall of the tube and send forward a chitinous rod into the body cavity.

Colpocephalum osborni. (Plate XIV, fig. 6).

The genitalia of this species are very similar to those of *Trinoton luridum* just described. The only difference is that the processes arising from near the posterior ends of the prongs of the fork-shaped structure do not meet each other. In addition to these, however, there is present in the dorsal wall of the membranous penis a chitinous arrowhead-shaped plate, which reaches about half way to the ends of the lateral prongs and is

connected with the latter by wings from its base, which reach the prongs a short distance back of their divergence. There are also developed in the walls of the penis numerous small, granular chitinizations.

Physostomum diffusum. (Plate XIV, fig. 3).

The chitinous genital parts of this species are very simple. There are present in the walls of the penis two diverging lateral rods which meet in front. Here they send forward into the body cavity a very small rod, it being about a third of the length of each outer prong, to which muscle fibers are attached. The posterior ends of the prongs are connected by a transverse, angular bar.

Menopon mesoleucum. (Plate XIV, fig. 10).

A long, rather thick, internal rod is present. This arises from the united anterior ends of two thick bars in the walls of the penis. These bars are very short and do not nearly reach the end of the penis. To the end of each is articulated a longer tapering rod free from the penis and reaching to its posterior end. These have the appearance of being homologs of the articulated lateral prongs in some of the Ischnoceran forms.

RÉSUMÉ.

From the preceding descriptions it is clear that the outer genitalia of the male may be generalized as follows. The posterior end of the last abdominal segment is invaginated to a varying extent, forming a genital chamber surrounded by the walls of the body, possessing a chitinous lining continuous with the body-wall, and opening posteriorly to the exterior. Into its anterior end the ductus ejaculatorius opens, and the

part in which the operation occurs is carried backward

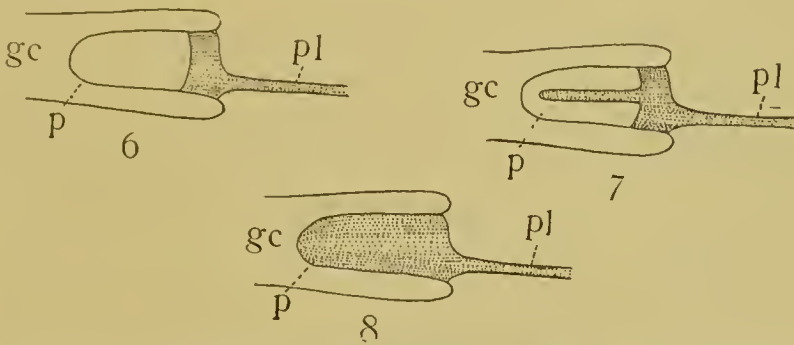


Fig. 5.—Diagram of external genitalia of male Mallophaga; *a*, anus; *gc*, genital chamber; *ej*, ejaculatory duct; *p*, penis; *pl*, internal plate arising from chitinous thickening in base of penis.

as an invagination forming an internal tube arising from the anterior wall of the genital chamber. This tube is the penis. Figure 5 represents diagrammatically what has just been described. It is evident that if the inner walls of the genital chamber are flexible the penis could be entirely protruded from the cavity containing it. Specimens killed in alcohol are often found with the penis projecting in this manner. The anal segment is lacking, so that the rectum opens into the genital chamber.

The chitinous genitalia are formed as chitinizations in the walls of the inner tube. The object of this is double, (1) to strengthen the walls of the penis, (2) to give attachment to muscles for protruding and retracting the penis. The latter function is apparently the more important, since a contrivance for its accommodation is never absent, while chitinous parts strengthening the penis are in some cases very slightly developed and in a few, such as in *Menopon titan*, yet to be described, and in some species of *Colpocephalum*, are entirely absent. The structure which gives attachment to the muscles is always of the form of a chitinous prolongation into the body cavity from a chitinization in

the ventral part of the base of the penis. It may, therefore, be represented as in figure 5, *pl*. This internal structure may be short or long and either narrow or broad, but it is always essentially the same and lies ventral to the ductus ejaculatorius. The external parts are developed as various degrees of chitination radiating through the walls of the penis from the ventral basal chitinous deposit. The simplest and most usual form consists of a rod given off backward on each side (fig. 6) such as in *Menopon mesoleucum*, *Trinoton luridum*, *Colpocephalum osborni*, and others.



Figs. 6-8.—Diagram showing successive degrees of chitination in walls of penis; *p*, penis; *gc*, genital chambers; *pl*, internal plate.

Secondary processes may be developed from these. In others the basal chitin may completely surround the penis (fig. 7) and, besides lateral processes, may give off dorsal and ventral ones as in *Goniodes cervinicornis*. Further, this circular basal chitination may extend continuously backward (fig. 8) and transform the penis into a chitinous tube, as in *Docophorus lari* and in *Eury-metopus taurus*. Independent chitinations may also be developed in the penis, taking the form of plates and granulations in its walls, as in *Lipeurus fuliginosus major*. It cannot be stated whether the articulated lateral processes are homologous with the non-articulated

lateral pieces or not—embryology must decide this. However, since the two are not known to be present in the same form, and since in *Goniodes cervinicornis*, at least there are non-articulated processes free from the lateral walls of the penis, it might be inferred that the two may be homologous.

Comparison shows that the simplest forms of external genitalia occur in the Amblycera, and that in none of these are the parts much complicated. On the other hand, the genitalia in nearly all the Ischnocera are very much more developed, and are characterized by a much wider spreading of the chitin in the walls of the penis, and of a relatively much larger development of the internal process. The condition of the external reproductive organs in the two suborders hence agrees with that of the internal organs, for it was before shown that the latter are the more specialized in the Ischnocera.

The structure of the intromittent apparatus of *Menopontitan* will now be described (plate xiii, fig. 10, and plate xv, figs. 2-5). It is so very highly developed and so complicated, being much more so than in any other form known, that it is more easily understood after a study of the more typical structure found in other species. Grosse has described it but apparently not very correctly. He says that the last abdominal segment of the male is invaginated and runs forward in the body to the border of the last and penultimate segments, and then goes again backwards in order to continue anew anteriorly, tube-like, to the sixth segment. Surrounding this are transverse muscles, and attached to its anterior end longitudinal muscles. He next states that within the invaginated segment is a tube open at both ends, which anteriorly passes into a gradually decreasing

chitinous rod reaching to the third abdominal segment, and that within this tube is still another which continues anteriorly into a whip-lash beset with numerous spines or bristles. It is rather hard to imagine how structures such as these could exist in the manner described; and dissected specimens, entire specimens cleared with *Eau de Labarraque* and stained, and sections cut in longitudinal and transverse directions, indicate that Grosse's description is not entirely correct. The structure of the various parts which Grosse has mentioned is apparently as described in the following account.

When the abdomen of the male is opened from above there is to be seen in it, lying along the middle line and ventral to the alimentary canal, a large, compact mass of muscles reaching from the last segment into the fourth. The posterior three-fourths of this mass is composed of transverse fibers, and the anterior one-fourth of longitudinal fibers which converge to a point in the fourth segment. This structure forms the most prominent organ in the abdomen and is easily taken entire from the body by detaching it from the body-wall at the posterior end. Under a low-power lens it can easily be seen that the transverse muscles of the posterior three-fourths are much curved, but are a little less than semicircular. Their dorsal ends are attached to a vertical sheet of membrane which extends down between them from above as a fold from a thin membrane surrounding the whole mass. Their lower ends are attached to a thin, transverse, ventral plate. By dissecting the fibers apart it is found that they, together with the ventral plate to which their lower ends are attached, surround a cylindrical cavity. Within this is a thin-walled, membranous tube open in front. This

latter contains a second thicker and more chitinous tube and a chitin rod. The rod arises posteriorly from the inner tube. Between the outer tube and the muscles on the dorsal side of the former lie the forward-running parts of the vasa deferentia. These enter the muscles posteriorly and then pass into the upper part of the cavity within them, run forward to the anterior end of this, and then emerge to join soon the seminal vesicle. The inner tube and rod pass forward some distance beyond the anterior end of the outer tube, and the former is thrown into several convolutions which vary in different specimens. The anterior longitudinal muscles arise from the anterior end of the mass of transverse muscles and converge upon the tip of the chitin rod. From these a small band of fibers continues into the thorax, where it is attached to the floor of the metathorax in the middle line. The transverse muscles, when detached from the ventral plate, but left with their upper ends still joined to the vertical membrane, have very much the appearance of a bunch of fire-crackers, the fold of membrane representing the axial fuse.

The inner tube on account of its being more strongly chitinous than the other appears dark, while the outer is transparent. The interior of the inner tube is beset with numerous chitinous projections. In the posterior part these are of the form of small conical processes closely distributed over the walls. Somewhat farther forward they increase in length and form sharp backward-pointing teeth. Still farther in front they become much more elongated, and anterior to these they take the form of large backward-projecting, spike-shaped appendages having sharp points, and they almost obstruct the lumen of the tube. Beyond these a decrease in size of the processes takes place, and in the walls of the

anterior part of the tube they are entirely lacking, the tube being here transparent. Beginning at the posterior end the tube runs straight forward to near the anterior end of the transverse museles. In the longitudinal museles it becomes folded and a loop may project from the latter. It is here of greatest diameter. It becomes narrowed in the part that has no internal processes and gradually passes into the comparatively narrow ejaculatory duet. To its posterior end the chitin rod is attached. This is circular in transverse sections, rather long since it reaches into the fourth segment, and tapering anteriorly. It is curved, having the convexity to the right and dorsally.

The relationships of these different parts is very clearly shown by transverse and longitudinal sections (plate xv, figs. 2-5). The posterior end of the last (the ninth) abdominal segment is deeply invaginated, the invagination running forward into the fifth segment. The walls of the tube thus formed (plate xv, figs. 2, 3, 4, t_1) are very thin and transparent, being entirely non-chitinized. In the anterior part of the sixth segment, however, they begin to increase in thickness and continue to become thicker from here forward to their anterior ends in the fifth segment. Here they turn away from the axis of the tube they form and then curve backwards a short distance. Then they become thin again and turn sharply forward and inward, closely following the inner face of the first bend. This is the beginning of an evagination which extends backwards almost to the beginning of the first. The walls of this are likewise very thin and transparent, and are closely applied, except posteriorly, to the inner surface of the first tube. There is thus formed a double-walled tube open in front and having a recurved anterior edge.

This is the outer of the two tubular structures to be observed by dissection alone and it is surrounded by the transverse muscle-fibers (plate xv, figs. 2, 3, 4, t_1 and t_2). This is probably what Grosse referred to as a tube open at both ends.

In the anterior part of the eighth segment the walls of the inner tube diverge from those of the outer one, leaving a free space between them connected with the exterior. A short distance back of where the two diverge the walls of the inner tube are bent backward and then again forward, forming a free cylindrical fold projecting backward. This extends posteriorly to the middle of the last segment and then ends by being invaginated and forming within itself a third tube (plate xv, figs. 2, 3, 4, t_3). The posterior part of the walls of these two are fused for a short distance and closely united as far forward as the fold in the second. Here the innermost tube becomes entirely free and lies as within a sheath surrounded by the first and second tubes. This is the inner tube so easily determined by dissection; it runs forward as before described, passing out of the cavity between the other tubes and entering the longitudinal muscles (plate xv, figs. 2 and 5 t_3 , and plate xiii, fig. 10 *int*). The chitinous rod (plate xv, figs. 2-5, r , and plate xiii, fig. 10, r) is attached to the fused part of the second and third tubes back of the posterior fold of the former. Only its anterior end is shown in median longitudinal sections. It is the homolog of the internal rods or plates of the chitinous genitalia already described.

It is readily seen that the intromittent organ of *Menopon titan* is simply an exaggeration of the type of that found in other species. It consists first of a deep invagination of the body-wall, extending from the

posterior end of the last abdominal segment forward into the fifth. (Grosse states that this is the turned-in tenth segment of the male. Beyond the fact that the male has one segment less in the abdomen than the female, he gives no evidence for this conclusion). The cavity thus formed corresponds exactly with the genital chamber of other species. Into the posterior part of it the rectum opens from above. Its anterior end is evaginated, and the tube thus formed is homologous with the membranous penis of other forms. It is almost destitute of chitinization, however; the rod arising in other species from the base of the penis is here situated near the tip. It appears from this that the elongation of the parts has been brought about, not by a deepening of the genital cavity with a corresponding lengthening of the penis in a posterior direction, but by a deepening of the genital cavity with a lengthening of the penis in front of its base. The innermost tube is produced by an invagination of the posterior end of the penis and is either unrepresented in other forms or is comparatively extremely short. Figure 9 represents diagrammatically

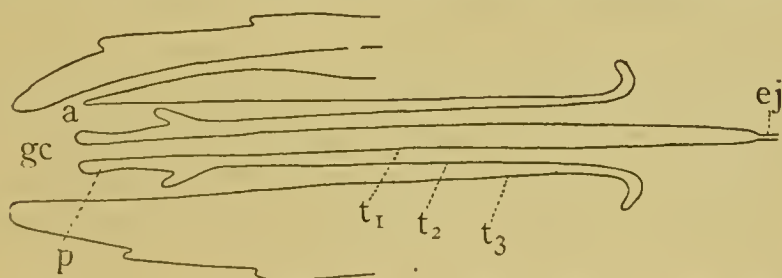


Fig. 9 —Diagram of Intromittent organ of *Menopon titan*, male; *a*, anus; *gc*, genital chamber; *ej*, ejaculatory duct; *p*, penis; *t*₁, innermost invaginated tube; *t*₂, middle invaginated tube; *t*₃, outermost invaginated tube or wall of genital chamber (cf. fig. 5).

the relation of the several tubes, and a comparison of this figure with fig. 5 shows the similarity of structure. (cf. also plate xv, fig. 2 with fig. 1).

The muscles surrounding the tubular structures are also very complex, as has been shown. The plate to which the ventral ends of the transverse fibers are attached arises from the body-wall between the sterna of the eighth and ninth segments of the abdomen (plate xv, figs. 2 and 4, *p*). The proximal end of this plate is non-chitinized but farther forward it becomes darker. It ends in the ventral part of the groove formed by the recurved ends of the first and second tubes. Its lateral edges curve somewhat dorsally. The muscles are surrounded by a very thin, delicate membrane (plate xv, fig. 2, *m*) which along the median dorsal line sends a fold downward a short distance to which the upper ends of the transverse muscles are attached. In the middle the muscles are seven or eight fibers deep but the number lessens toward each end. They curve laterally around the tubes and each layer is attached to the ventral plate internal to the layer just outside it.

The longitudinal muscles, as stated, form a conical mass of fibers converging upon the anterior end of the rod, from which a few run forward to the sternum of the metathorax. There are a few transverse muscles within the others, especially close around the contained tube (plate xv, figs. 2 and 5, *lm*). It is rather difficult to determine how the longitudinal muscles are attached posteriorly. It appears clear, however, that they are not attached to any of the tubes but to the ventral plate, and in the following manner: The anterior end of the plate curves laterally very much upward around the outermost tube. The upper lateral and dorsal fibers posteriorly, in front of the recurved anterior ends of the first and second tubes, curve downward and inward, crossing each other in the middle line. They then turn backward, passing over the rim of the tubes, and

are attached mostly to the lateral ventral aspects of the anterior end of the ventral plate, but a few are attached on the dorsal side. The lower lateral and ventral muscles likewise cross each other in the middle line in front of the tubes and are attached to the lateral aspects of the dorsal side of the anterior end of the ventral plate. The mechanism of this complex structure is rather hard to understand. It is evident that the contraction of the longitudinal muscles must push the rod outwards, carrying with it the innermost tube. The posterior fold in the second tube appears also, as if present to accommodate such an action. Grosse states that during copulation the whole inner tube is everted. It is difficult to understand what it is for if it is not made use of in this way, but it is much more difficult to see by what means it is turned out, since in front of the attachment of the rod at its posterior end it is entirely free from everything except the ejaculatory duct. Those specimens examined in which the inner tube was most everted had this protruded only as far as the base of the rod, the longest length apparently possible, judging from the structure of the parts. There can be little doubt that the band of muscles connecting the anterior end of the rod with the floor of the metathorax serves to draw the rod back. The transverse muscles may serve to prevent the lateral bending of the rod while the longitudinal muscles are contracting.

2. THE FEMALE ORGANS.

The reproductive organs of the female consist, like those of the male, of internal and external parts. The external part consists merely of the genital cavity, with the abdominal sternum forming its floor produced into a variously modified plate. The genital cavity differs

from that of the male in not being situated in the terminal segment of the body, but by being found as an invagination of the ventral body-wall several segments forward. It also does not contain the anal opening, this being situated terminally in the last segment.

The external parts of the female are much the same in all forms and the female *Menopon titan* may be described as a type of the whole order. Grosse describes the female organs of this form, but only very briefly, and he says nothing at all of the external parts. The sternum of the eighth abdominal segment is considerably modified. It consists mostly of a large depressed plate (plate xvii, fig. 7, *pl*) produced on each side into two ventrally projecting ridges divergent behind. The posterior border is free, above it is the external genital opening (*gc*), a narrow transversely elongated aperture. It opens into a cavity, the genital chamber, situated above the plate. The structure is best studied by means of transverse and longitudinal sections. Longitudinal sections (plate xvii, fig. 6) show that the genital chamber (*gc*) is formed as an invagination of the sternum of the eighth abdominal segment, a short distance in front of the posterior border of the latter. The vagina (*v*) opens into the upper part of its anterior end by a terminal downward curvature. It is lined by a continuation of the chitinous wall of the body. Transverse sections (plate xvii, figs. 1-3) show that the depressed plate of the eighth abdominal sternum is W-shaped. The tergum of the segment forms a large, continuous, arched plate extending on each side to the lateral edge of the body. Here a non-chitinized line occurs, separating the tergum from a pleural chitinization situated laterally on the ventral aspect. The inner edges of these are united by unchitinized spaces.

with the outer arms of the W-shaped sternum. Each angle of this, again, is free from ehitin. The lateral walls are thick and especially so at their bases, where they are produced into a large, inward-projecting ridge (*b*). The non-ehitinization of the angles of the sternum and of its union with the pleural sclerites makes it evident that it is formed to enlarge by a diverging of the sides of the lower angles when an egg passes into the genital chamber. The inner lining (*ci*) of the latter is thin but mostly ehitinized. A large mass of transverse muscles (*tm*) surround the inner wall, being attached latterly to the walls of the sternum and their enlarged bases. Back of the vaginal opening their inner ends are attached to a longitudinal dorsal crest of the inner wall of the cavity. A few longitudinal muscles (*lm*) also are present.

The genital cavity is wide posteriorly but becomes narrower in front. It is almost divided into two longitudinal chambers by the dorsal ridge of the ventral groove of the sternum. The vagina opens into its anterior end somewhat to the right. This is a large tube and must be regarded as a part of the exterior since it possesses a chitinous intima continuous through that of the genital cavity with the exterior covering of the body. From the genital chamber the vagina (plate xvii, figs. 2-5, *vo*, *av*, *pv*, and *cv*) runs a short distance dorsally and then turns forward. It forms a large U-shaped tube (plate xvi, fig. 3, *va*) lying in the ventral part of the abdominal cavity, with the closed end reaching far forward. Sometimes it is somewhat spirally twisted upon itself. The anteriorly running arm begins at the anterior end of the genital cavity to the right of the other backward running arm (plate xvii, figs. 2, 3, 4, *vo*, *av*, *pv*). The latter is

generally expanded near its middle but becomes narrower posteriorly, reaching back of the opening of the other arm into the genital chamber. Here it makes a bend to the right (plate xvii, fig. 1, *pv*) and becomes continuous with the oviduct (*od*).

The muscles surrounding the genital cavity are continuous over the vagina, forming circular muscles around it which continue throughout its whole length. Outside of these are a few transverse muscles. Grosse states that the muscles begin near the opening. Within the muscles is a structureless membrane which forms the true outer covering of the vagina. Within this is a cellular epithelium lined by a chitinous intima thrown into large folds projecting into the lumen.

The oviduct (plate xvii, figs. 1-6, *od*) is very long and somewhat coiled. It varies greatly in different specimens, but always runs forward from the anterior end of the vagina as an apparent continuation of it. It is first closely or openly bent upon itself, and then runs again forward to near the anterior end of the vagina, where it bifurcates, each tube running outward and backward, bearing at its end the egg-tubes of the same side. According to the specimen the oviduct may be very narrow or greatly distended. It is formed of the same elements as the vagina except that it lacks the chitinous intima. The inner ends of the epithelium cells (plate xvi, fig. 4, *ep*) project irregularly into the lumen, and the latter is generally almost obliterated by the approximation of the cells, which are much larger than those of the vagina. The muscle layers, on the other hand, are not so thick.

The egg-tubes are five in number on each side. They arise from the distal ends of the oviducts and have the same structure that they show except that the

outer covering of muscles is lacking. Each is a long slender tube dilated where it contains ova into chambers which decrease in size distally. The five tubes on each side are united at their anterior ends and form a tangled mass on each side of the body. Each tube (plate xvi, fig. 6) is surrounded by a close, outer, structureless membrana propria (*mp*). Within this is an epithelium composed of a single layer of cells. When there is no egg present in the ovary these cells are all very large (plate xvii, figs. 3-5, *o*) and almost fill the lumen of each tube. They appear triangular in transverse sections, while their bases on the membrana propria are polygonal. A large, radially elongated nucleus is present in each. When ova are present in the ovaries the egg-tubes present a very different appearance (plate xvi, fig. 6). Each egg is surrounded by a follicle formed by an enlargement of the tubule. In the lower chambers (*a*) are to be found fully formed eggs (*o*). They are surrounded by a thick egg-covering filled with granular yolk. In form they are elongated and flattened at each end. The epithelium (*ep*) of the walls of a lowermost egg-chamber is composed mostly of small cubical cells. Posteriorly they are elongated, forming a transverse posterior wall for the chamber in the middle of which is the opening into the proximal part of the tubule connecting the egg-chambers with the oviduct. In front the epithelial cells become successively longer, until the most anterior are very long and slender, those from opposite sides almost meeting one another. In front of these are four immensely enlarged cells (*ac*) entirely filling the lumen of the tubule and thus closing the anterior end of the egg-chamber. These retain the form of the cells of an inactive tubule. The small epithelial cells are

lined by a distinct intima, which is apparently absent when there is no egg present and the cells are large.

The smaller egg-chambers (*b*) contain a granular mass of yolk (*g*) which is not surrounded by a covering of its own. The epithelium is the same as in the lower chamber, except that the anterior cells are not elongated. Filling the anterior end of the enlargement of the tubule are six large cells. The part of the tubules connecting two egg-chambers is slender, with small epithelial cells.

Grosse states that there is present on each side of the vagina a club-shaped spermathæca. In the specimens of *Menopon titan* examined, however, there was no organ of this kind present.

In *Eurymetopus taurus* (plate xvi, fig. 1) the vagina (*va*) consists of a large, wide, straight, invaginated tube reaching forward to the fifth abdominal segment. Into its anterior end open two oviducts, one from each side. Into the posterior end on the dorsal side a duct opens, connected at its distal end with a large, dorsoventrally flattened, glandular organ (*g*). The cells of this are very large and distinct (plate xvi, fig. 2). The duct is divided into a wide distal and narrower proximal part. The posterior end of the first is invaginated and the second part arises from the inner end of this. Numerous muscle-fibers (*m*) are attached to the upper part around its middle. Spermatozoa were not found in the gland. This appendage is constant, but the pouch referred to varies a great deal.

The oviducts are simple tubes extending outward, anteriorly and dorsally into the fourth segment. They are sometimes narrow tubes with enlarged bases and are sometimes wide throughout their whole length. Each bears at its distal end five egg-tubules. These

sometimes join the oviduct serially as in fig. 10, or two or more may be united at their bases as shown in figs. 11 and 12.



Figs. 10-12.—Variations in attachment of egg-tubules to the oviduct in *Eurymetopus taurus*.

Nitzseh states that in the *Ischnocera* there are five egg-tubes present in the females, while in the *Amblycera* there are but three. He expresses a doubt though whether this second statement holds for the suborder. Rudow (1870) states that in both groups five are present but that in the *Amblycera* (*Liotheum*) two remain rudimentary. Even this statement is not entirely true, for there are five well developed in the adult *Menopon titan*. Sections of a young *Menopon persignatum* show four fully formed tubules and one small one. Adults of *Colpocephalum osborni* show three well developed and one small one on each side. In *Trinoton luridum* there are four in the adult. Grosse in his paper on the anatomy of *Tetraphthalmus chilensis* (*Menopon titan*) quotes Nitzseh's statements in regard to the number of egg-tubes, but adds no observations on the number present in the form he describes. Nitzsch figures the female organs of *Menopon mesoleucum*. According to him there is present a short, wide vagina, narrowed in front where it gives off on each side an

oviduct. Each of these bears distally three egg-tubes. A double spermathæca opens into the base of the vagina. He figures also *Goniodes dissimilis*, in which the vagina is a straight tube branching in front into two rather wide oviducts into which open five egg-tubes. Into the posterior side of each duct three blind tubes open internal to the ovarian tubules. Kramer describes the female organs of *Lipeurus jejunus*, giving five as the number of egg-tubes present.

From the descriptions just given it is evident that the two suborders differ from each other in regard to the female organs simply in that there is a tendency amongst Amblyceran forms toward a reduction of the number of ovarian tubules from five—the constant number in the Ischnocera—to three.

The eggs (plate xvii, fig. 8) are large, oval, and generally rather elongated. They are attached to the bases of the feathers singly or in groups. On birds badly infested large numbers of eggs may be found. They are fastened by one end, having that end from which the embryo will emerge directed toward the tip of the feather. When the embryo leaves the egg it pushes off a circular cap and partly protrudes itself. In *Docophorus fuliginosus* the embryos apparently remain in the mouth of the open egg for some time, for many were found in this position. Some found thus were very immature (plate xvii, figs. 9 and 10), having the mandibles entirely unchitinized, the maxillæ almost as large as the mandibles, and the labium large, consisting of a transverse basal position and two lateral lobes. The most immature of those found free from the egg had the mandibles well chitinized.

Little has been done on the embryology of the Mallophaga. The work of Nusbaum (1882) on the

development of the reproductive organs has already been referred to. Melnikow (1869) made a more general study of the embryology, but since he concluded from his investigations that the Mallophaga are closely related to the Pediculidæ—a conclusion entirely untenable—his work cannot be very accurate. He proves that there is present a beak but no labium, and hence that the mouth-parts are Hemipteran!

VII. SUMMARY.

The foregoing descriptions of the various systems of organs of the Mallophaga show that the two suborders are separated by wide structural differences. These may be tabulated as follows:

<i>Amblycera.</i>	<i>Ischnocera.</i>
Mesonotum and Metanotum Distinct.	Mesonotum and Metanotum Fused.
Antennæ concealed.	Antennæ exposed.
Antennæ clavate.	Antennæ not clavate.
Mandibles horizontal.	Mandibles vertical.
Labial palpi present.	Labial palpi absent.
Paraglossæ various in form.	Paraglossæ constant in form.
Œsophageal sclerite and connected glands absent or modified.	Œsophageal sclerite and connected glands present and normal except in a few scattered cases.
Crop simple.	Crop an œsophageal diverticulum.
Salivary glands various in form.	Salivary glands constant in form.
Ingluvial glands absent.	Ingluvial glands present.
Testes six.	Testes four.
Chitinous ♂ genitalia simple.	Chitinous ♂ genitalia more complex.
Egg-tubes three to five.	Egg-tubes five.

The above table shows that in nearly every character in which the two suborders differ the Ischnocera have a more specialized organization. That the separation of the two groups is very great is shown by the fact that nearly all the important organs are affected, the heart, tracheal system, and nervous system being the only ones alike in both. The exact systematic position of the Mallophaga cannot at present be determined, since enough of the anatomy of nearly related forms is not known. Packard (1887), however, has shown that they may be closely related to the Psocidæ, and Kellogg (1896) has given further evidence of this. But if the Psocidæ are the most closely associated with the Mallophaga, in what manner the two groups are related is impossible to say. Until this is known the relationship of the two suborders of the Mallophaga to each other cannot be determined nor that of the families composing these suborders.

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EXPLANATION OF PLATES.

PLATE X.—Fig. 1, Median dorsoventral longitudinal section of anterior half of *Menopon titan*; *h* head, *t*₁ prothorax, *t*₂ mesothorax, *t*₃ metathorax; *a*₁ first abdominal segment, *a*₂ second abdominal segment, *bw* outer body-wall, *bm* basement membrane, *m* mouth-opening, *bc* buccal cavity, *p* pharynx, *æ* œsophagus, *cr* crop, *v* anterior end of ventriculus, *sg* salivary gland, *b* brain, *s.æ. g* subœsophageal ganglion, *g*₁ prothoracic ganglion, *g*₂ mesothoracic ganglion, *g*₃ metathoracic ganglion, *tr* trachea, *lm* longitudinal muscle, *tm* transverse muscle, *o* anterior end of an egg-tube cut near the surface. Fig. 2, Throat skeleton with attached glands of *Eurymetopus taurus*; *æ. s* œsophageal sclerite, *l. g* glands, *d* duct, *ch. ped* chitinous pedicle. Fig. 3, Left maxilla, ventral aspect, of *Goniodes cervinicornis*. Fig. 4, Labial fork of *Ancistrona gigas*. Fig. 5, Mandibles, ventral aspect, of *Ancistrona gigas*. Fig. 6, Mandibles, posterior aspect, of *Goniodes cervinicornis*. Fig. 7, Œsophageal sclerite, dorsal aspect, of *Eurymetopus taurus*; *d* duct, *do* opening of duct, *m* median groove, *ant. p.* anterior process, *c. æ* circumœsophageal process. Fig. 8, Hypopharynx of *Ancistrona gigas*. Fig. 9, Labium of *Nitzschia dubius*; *sm* submentum, *m* mentum, *pf* palpifer, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 10, Right maxilla, ventral aspect, of a *Læmobothrium*. Fig. 11, Mandibles, ventral aspect, of *Læmobothrium* sp.; *c* condyles, *r* right mandible, *l* left mandible. Fig. 12, Right mandible, posterior aspect, of *Goniodes cervinicornis*; *c* condyle, *ch pls* chitinous plates. Fig. 13, Labium, ventral aspect, of *Eurymetopus taurus*; *sm* submentum, *m* mentum, *g* glossa, *pg* paraglossa.

PLATE XI.—Fig. 1, Salivary glands of *Trichodectes geomydis*; *a* outer gland, *b* inner gland. Fig. 2, Salivary organs of *Menopon titan* (after Grosse); *a* salivary gland, *b* saliva reservoir. Fig. 3, Large-celled salivary gland of *Trichodectes geomydis*, with the cells in natural position; *d* duct. Fig. 4, Same as last but with cells spread apart showing branches of duct (*d*) to individual cells. Fig. 5, Large-celled gland of *Eurymetopus taurus*; *d* duct. Fig. 6, Longitudinal section of part of Malpighian tubule of *Menopon titan*; *mp* membrana propria, *ep* epithelium, *in* intima. Fig. 7, Part of alimentary canal with Malpighian tubules of *Colpocephalum osborni*; *v* lower end of ventriculus, *i* upper end of intestine. Fig. 8, Alimentary canal of *Docophorus lari*. Fig. 9, Crop (*cr*) with part of œsophagus and ventriculus of a *Trichodectes* from a horse. Fig. 10, Alimentary canal of *Trichodectes geomydis*; *g* large-celled glands of crop. Fig. 11, Alimentary canal of *Eurymetopus taurus*, ventral view; *r* outer salivary gland or saliva reservoir, *g*₁ inner gland, *g*₂ large-celled gland. Fig. 12, Alimentary canal of *Goniodes cervinicornis*. Fig. 13, Alimentary canal of *Menopon titan*.

PLATE XII.—Transverse sections of *Menopon persignatum*. Fig. 1, Section through head in region of anterior end of brain. Fig. 2, Section through head in region of posterior part of antennary fossæ. Fig. 3, Section through head, passing through the eyes. Fig. 4, Section through posterior part of head. Fig. 5, Section through prothorax just back of the legs. Fig. 6, Section of mesothorax through bases of the legs. Fig. 7, Section of metathorax just in front of the legs; *æ* œsophagus, *an* antenna, *br* brain, *sg* subœsophageal ganglion, *e* eye, *tr* trachea, *h* heart, *l* base of mesothoracic leg, *f* fat-body, *cr* crop, *g*₁ prothoracic ganglion, *g*₂ mesothoracic ganglion, *c* nerve commissure in front of mesothoracic ganglion, *vw* thickened ventral wall of antennary fossa.

PLATE XIII.—Internal male genitalia. Fig. 1, Transverse section of testis of *Menopon titan*; *mp* outer tunica, *ep* epithelium. Fig. 2, Transverse section of vas deferens of *Menopon titan*; *mp* membrana propria, *ep* epithelium, *in* intima. Fig. 3, Reproductive organs of male *Goniodes cervinicornis*; *t* testes, *vd* vas deferens, *sv* vesiculæ seminales, *ej* ductus ejaculatorius. Fig. 4, Transverse section of ductus ejaculatorius of *Menopon titan*; *mp* membrana propria, *ep* epithelium, *in* intima, *m* circular muscles. Fig. 5, Transverse section of lower end of vesicula seminalis of *Menopon titan*; letters as in last. Fig. 6, Transverse section through middle of vesicula seminalis of *Menopon titan*; letters as in fig. 4. Fig. 7, Reproductive organs of male *Colpocephalum flavescens* (after Nitzsch); *t* testes, *vd* vas deferens, *sv* seminal vesicle, *ej* ductus ejaculatorius, *r* chitinous rod attached to inner tube of genital cavity. Fig. 8, Same of *Eurymetopus taurus*; letters as before. Fig. 9, Same of *Physostomum diffusum*; letters as before. Fig. 10, Same of *Menopon titan*; letters as before, but also, *ve* vas deferens, *cd* transverse duct connecting the two vasa deferentia, *int* innermost invaginated tube of genital cavity, having rod (*r*) attached to its lower end.

PLATE XIV.—External male genitalia. Fig. 1, Chitinous genital parts of *Lipeurus fuliginosus major*, dorsal aspect. Fig. 2, Same of *Goniodes cervinicornis*, dorsal aspect. Fig. 3, Same of *Physostomum diffusum*. Fig. 4, Same of *Giebelia mirabilis*. Fig. 5, Same of *Eurymetopus taurus*, dorsal aspect. Fig. 6, Same of *Colpocephalum osborni*. Fig. 7, Same of *Trinoton luridum*. Fig. 8, Same of *Docophorus lari*. Fig. 9, Same of *Goniocotes creber*. Fig. 10, Same of *Menopon mesoleucum*.

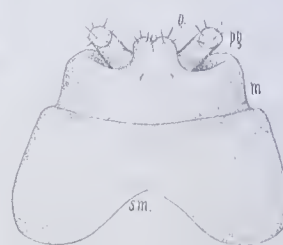
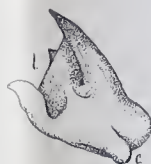
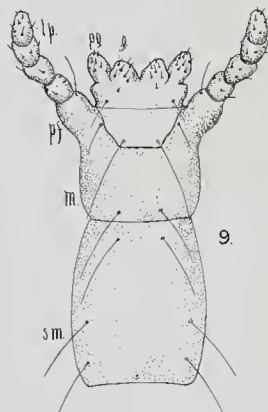
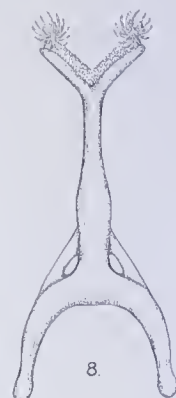
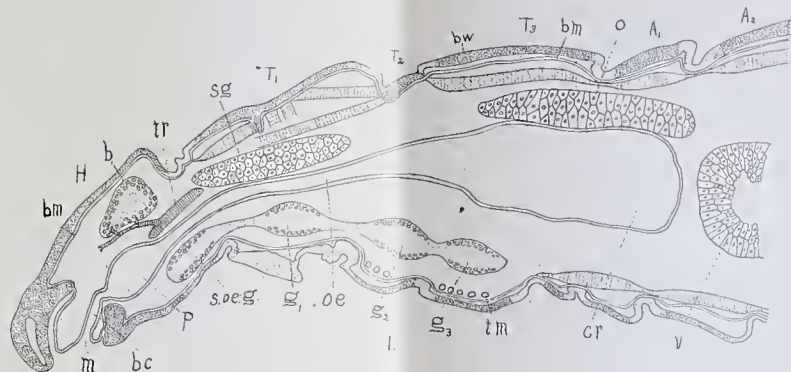
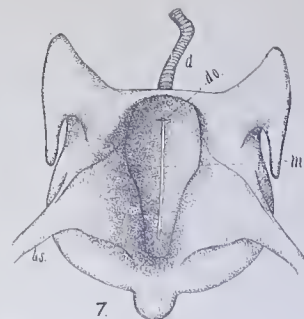
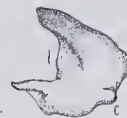
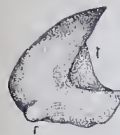
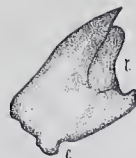
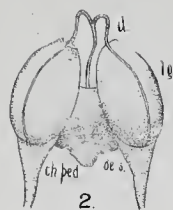
PLATE XV.—Fig. 1, Longitudinal section of two posterior somites of male *Eurymetopus taurus*. Fig. 2, Longitudinal section of six posterior segments of male *Menopon titan*. Figs. 3-5, Transverse sections of abdomen of male *Menopon titan*. Fig. 3, Through anterior end of segment VIII. Fig. 4, Through segment VII. Fig. 5, Through segment V; *tm* transverse muscles; *lm* longitudinal muscles, *em* extrusor muscles, *m* membrane surrounding muscles, *gc* genital chamber, *i* intestine, *a* anus, *p* penis, *pl* internal plate, *r* internal rod, *t*₁ outermost invaginated tube,

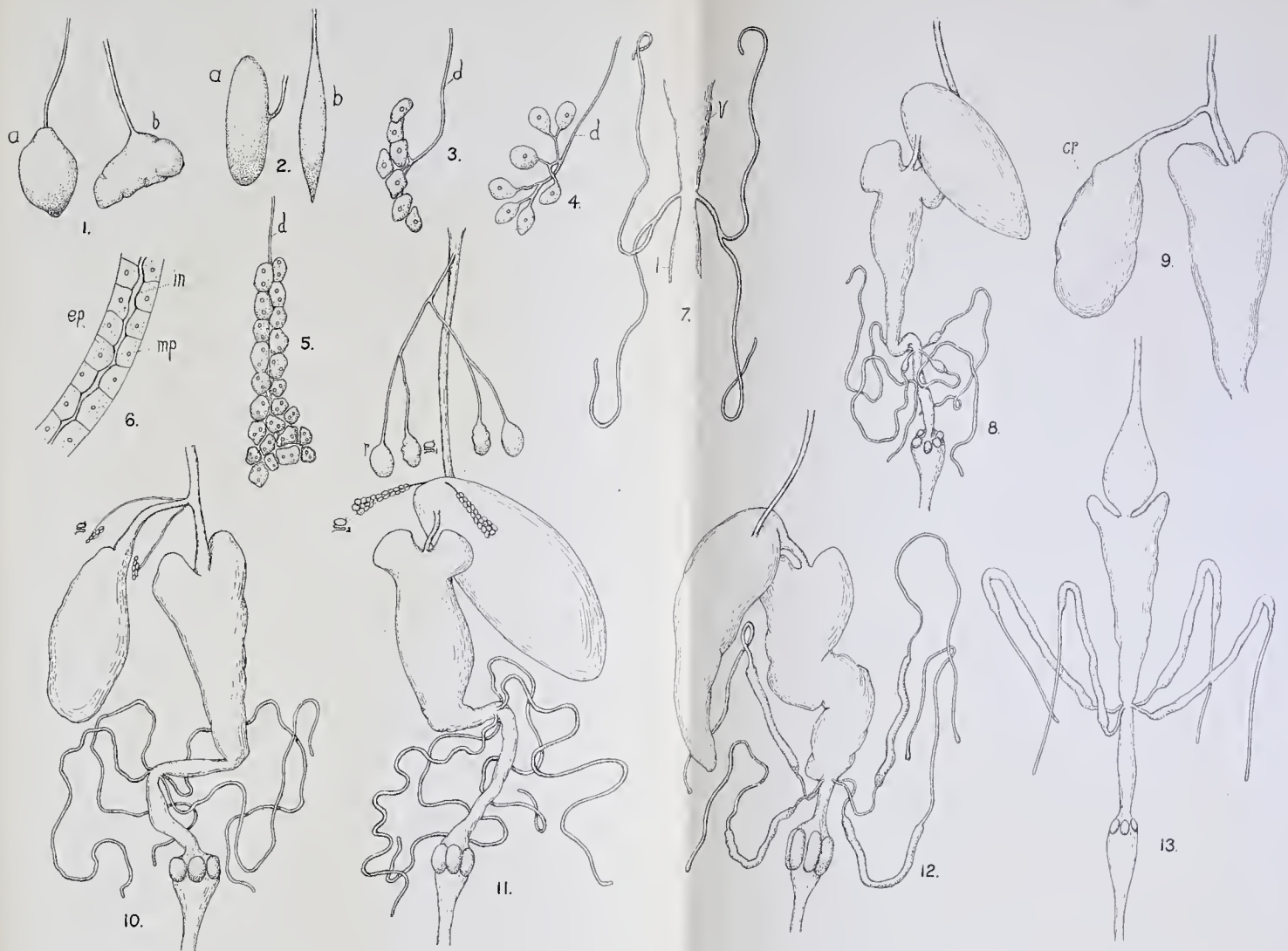
t_2 middle tube, t_3 innermost tube, re anterior recurved edges of outer and middle tubes, t testes, vd vas deferens, sv seminal vesicle, ej ejaculatory duct, vp ventral plate to which transverse muscles are attached, mt Malpighian tubule, f fat-body, tr trachea, tg tergum, s sternum, p pleuron.

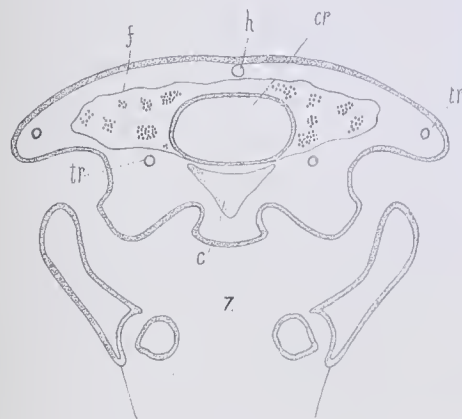
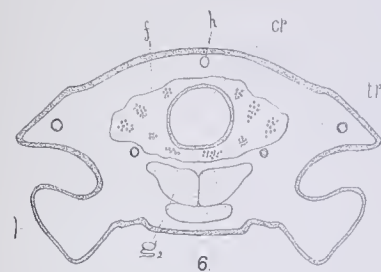
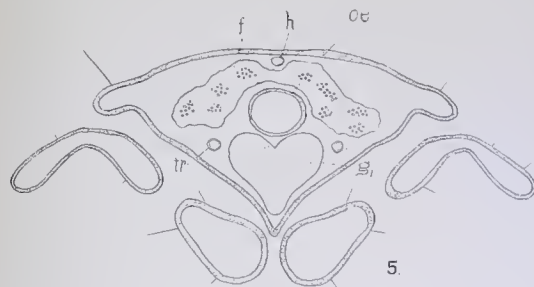
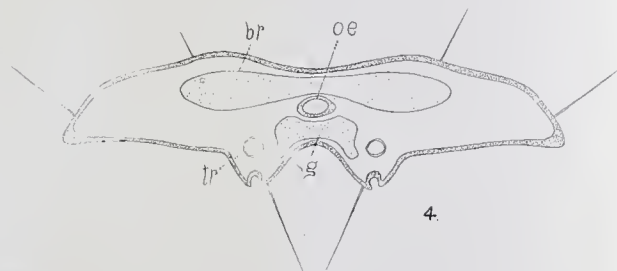
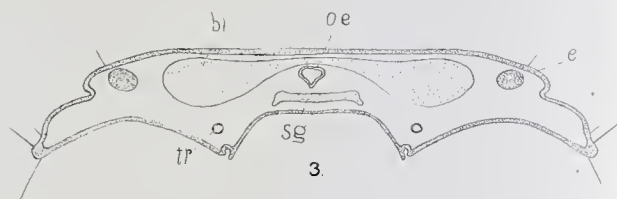
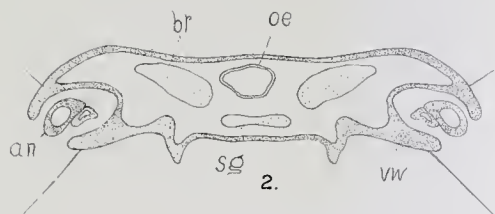
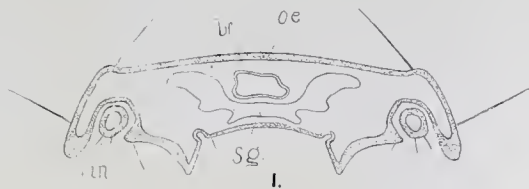
PLATE XVI.—Fig. 1, Reproductive organs of female *Eurymetopus taurus*; o ovaries, od oviduct, va vagina, sp spermathæca, g gland. Fig. 2, Accessory gland of female *Eurymetopus taurus*; d duct, m attached muscles. Fig. 3, Reproductive organs of female *Menopon titan*; o ovaries, od oviduct, va vagina. Fig. 4, Transverse section of oviduct of *Menopon titan*; ep epithelium, m circular muscles, mp membrana propria. Fig. 5, Detached egg-cap (See plate xvii, fig. 8). Fig. 6, Longitudinal section through an egg-tube of *Menopon titan*; a lowermost egg-chamber containing a mature egg (o), b an upper egg-chamber containing an immature egg (g), ep small epithelial cells forming side-walls of egg-chambers, ac very large epithelial cells filling the anterior ends of egg-chambers, mp membrana propria, in intima, od oviduct. Fig. 7, Nervous system of *Eurymetopus taurus*; b brain, sg subœsophageal ganglion, g_1 prothoracic ganglion, g_2 mesothoracic ganglion, g_3 metathoracic ganglion, tr trachea. Fig. 8, Longitudinal dorsoventral section of brain (b) and subœsophageal ganglion (sg), passing through the circumœsophageal commissure of *Menopon titan*; fg frontal ganglion.

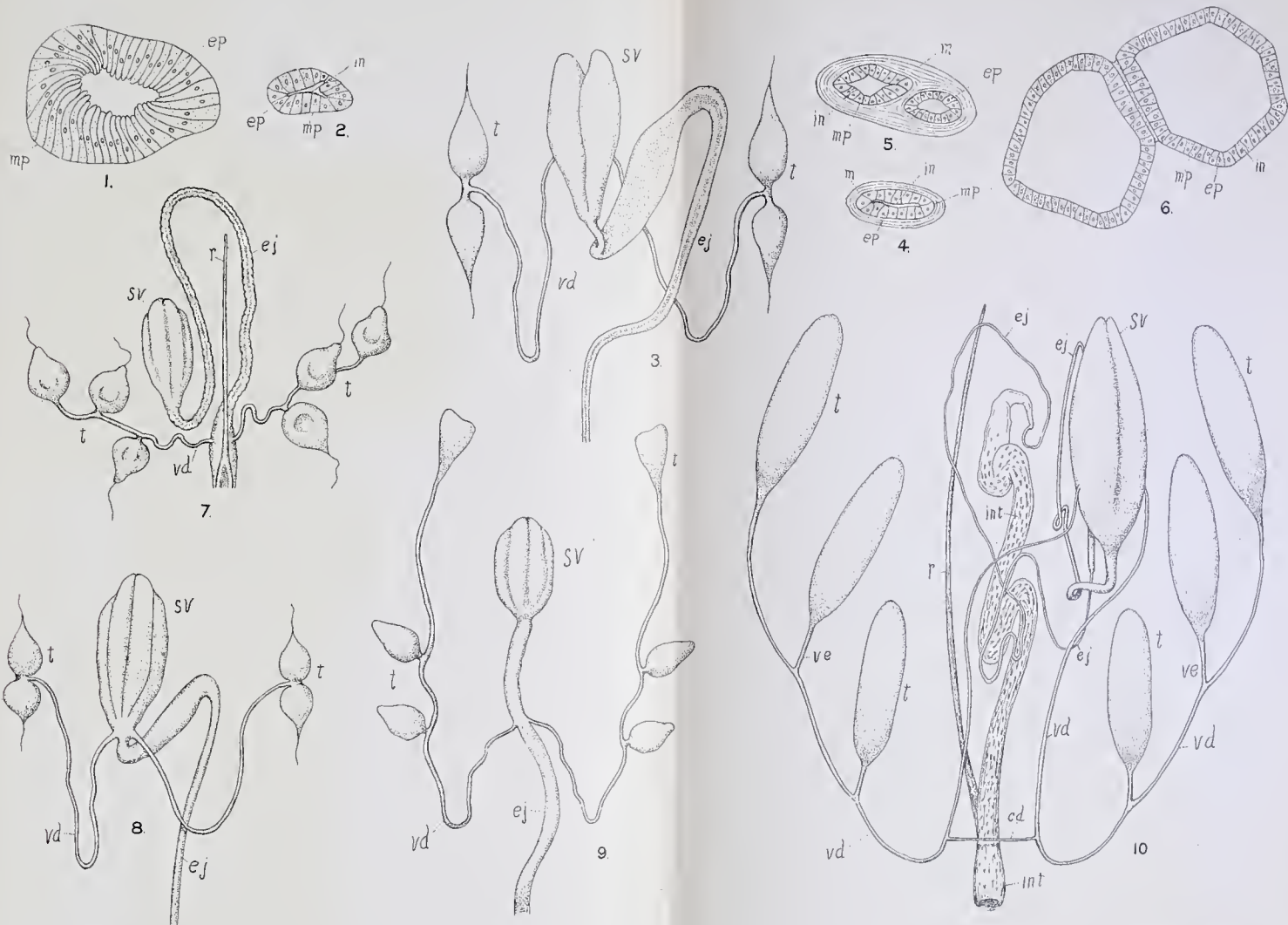
PLATE XVII.—Figs. 1-5, Transverse sections through posterior end of abdomen of female *Menopon titan*, from behind forward: Fig. 1, through middle of genital cavity (gc); Fig. 2, through the beginning of the vagina (vo); Fig. 3, cut in front of vaginal opening; Fig. 4, taken in front of genital cavity; Fig. 5, through anterior end of vagina; r rectum, rg rectal glands, tr trachea, f fat-body, gc genital cavity, tm transverse muscles, lm longitudinal muscles, ci inner chitinous wall of genital chamber, b enlarged base of outer chitinous wall of genital chamber, vo vaginal opening into anterior part of genital chamber, av anteriorly running part of vagina, pv posteriorly running part of vagina, cv anterior end of vagina where the two arms meet, o egg-tubes, pr prerectal part of intestine, od sections through the coils of the oviduct. Fig. 6, Longitudinal dorsoventral section of five posterior abdominal segments of female *Menopon titan*; bw chitin wall of body, bm basement membrane, m longitudinal muscles, a anus, r rectum, rtm transverse muscles of rectum, ch chitinous lining of rectum, rg rectal glands, gc genital chamber, v vagina, vtm transverse muscles of vagina, od sections of oviduct. Fig. 7, Ventral view of posterior end of abdomen of female of *Menopon titan*; VII, VIII, IX, X segments of abdomen, pl plate forming ventral wall of genital cavity, gc opening of genital cavity to exterior. Fig. 8, Three eggs attached to shaft of a feather; a egg containing an embryo, b empty egg with cap off. Figs. 9 and 10, Young nymphs just hatched; lb labrum, mn mandible, mx_1 maxilla, mx_2 labium, an antenna, m mouth-opening.













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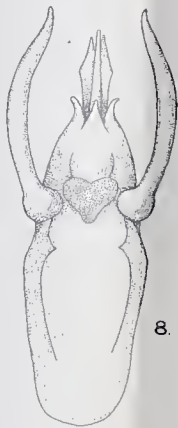
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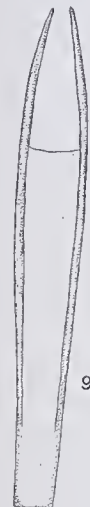
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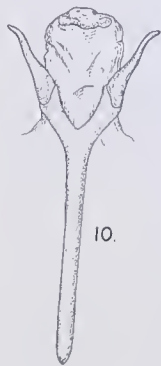
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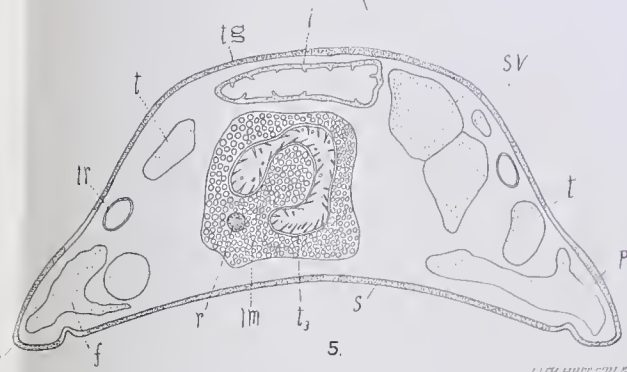
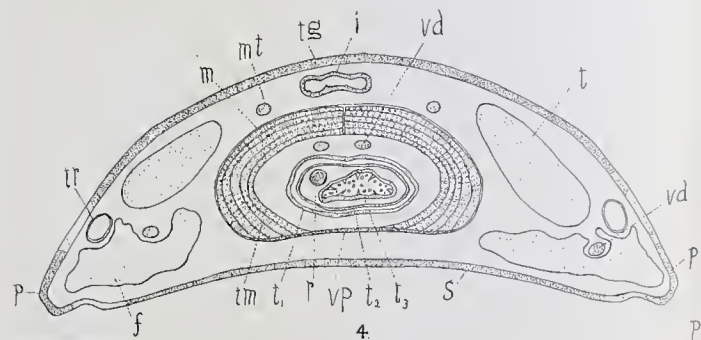
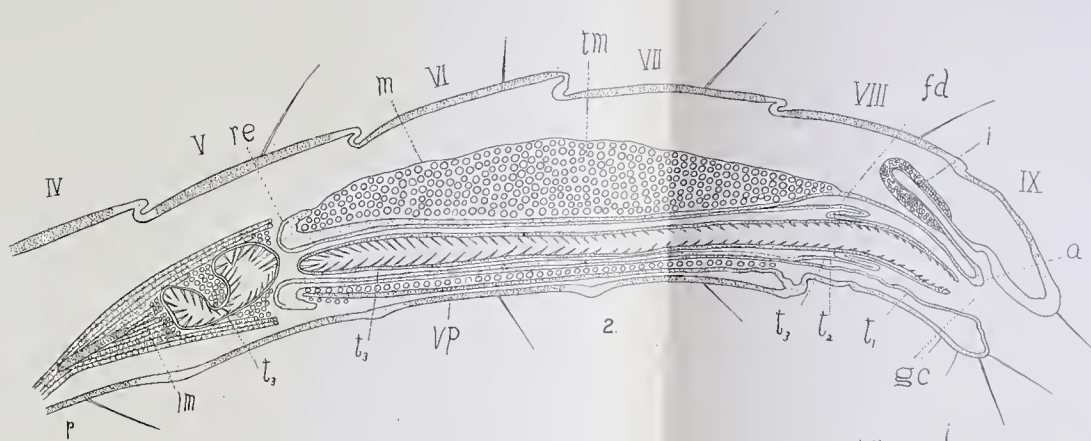
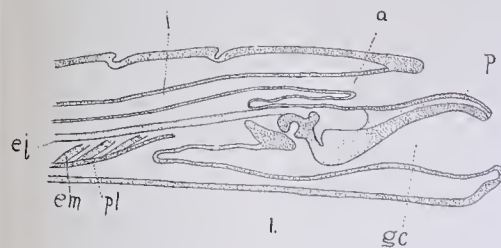
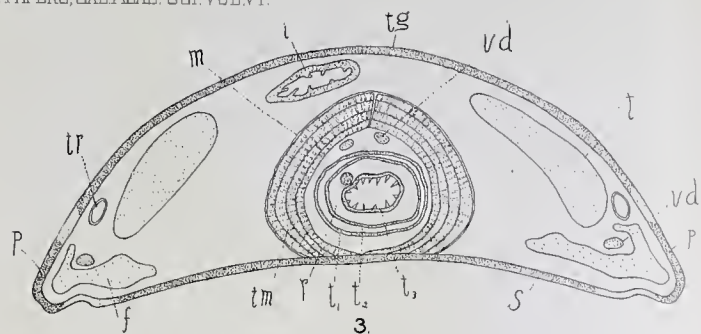
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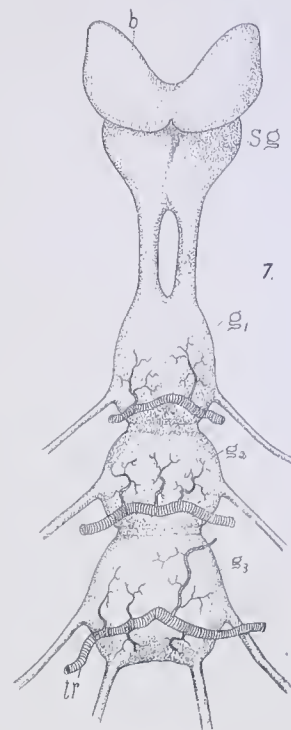
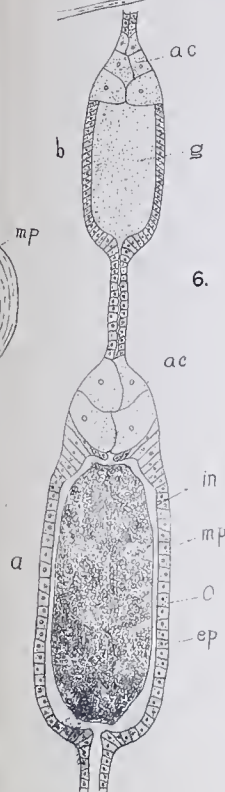
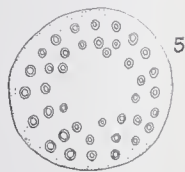
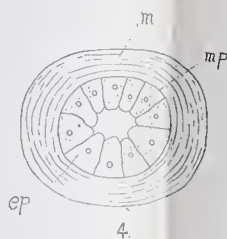
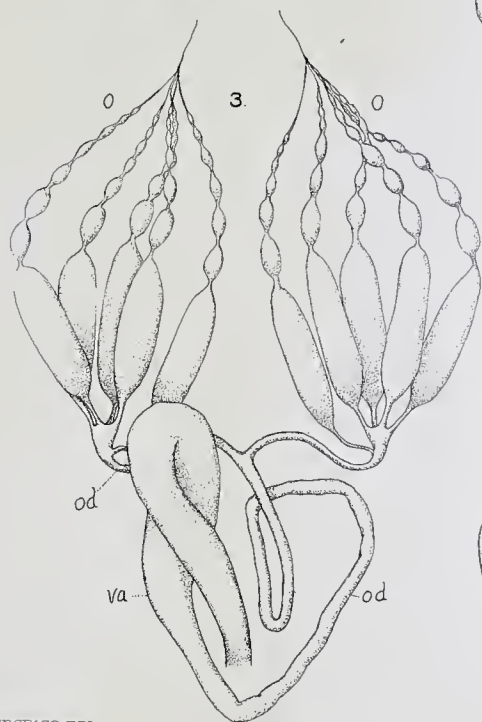
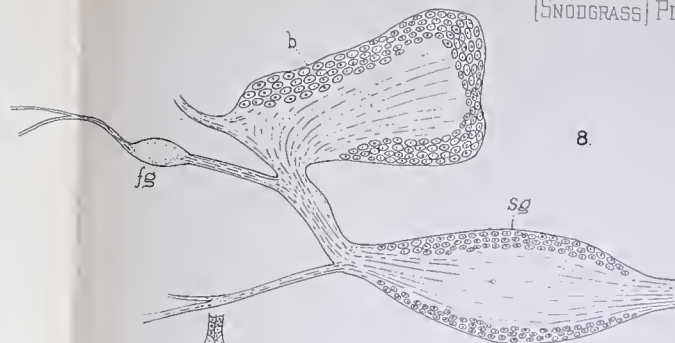
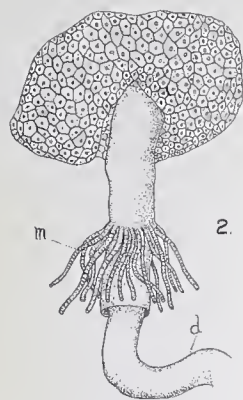
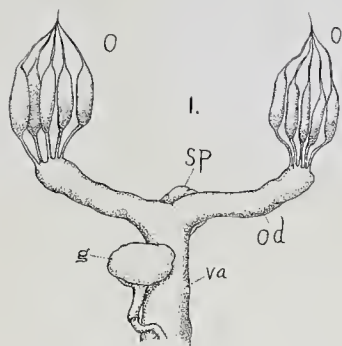


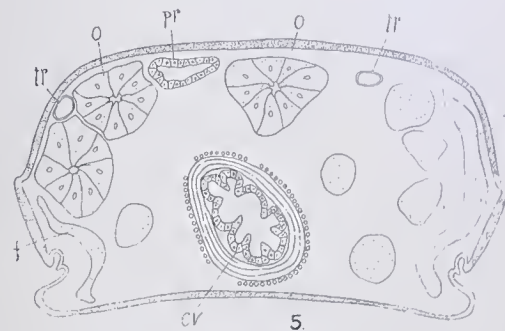
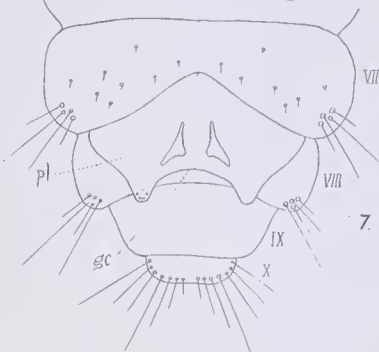
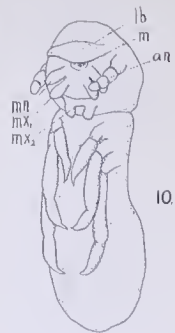
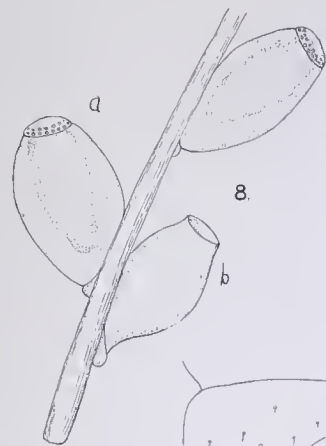
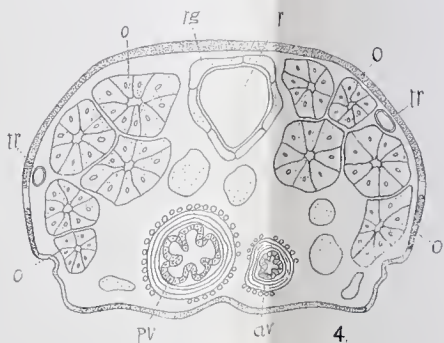
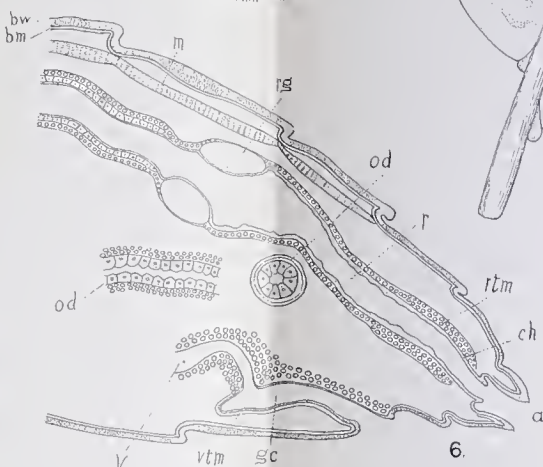
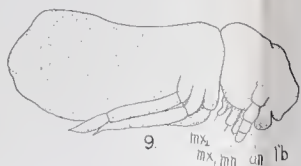
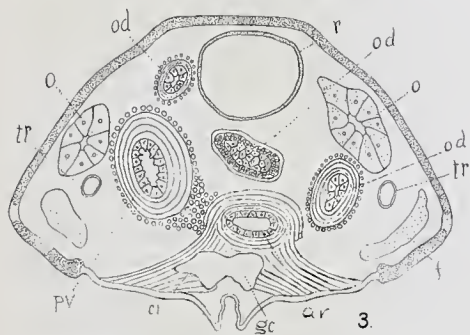
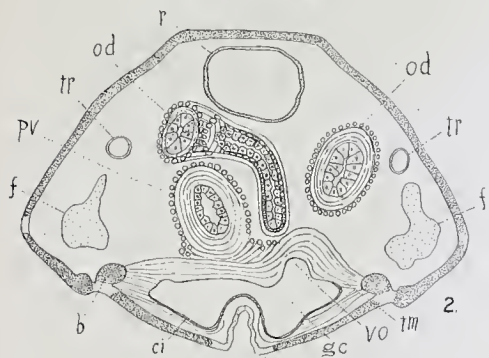
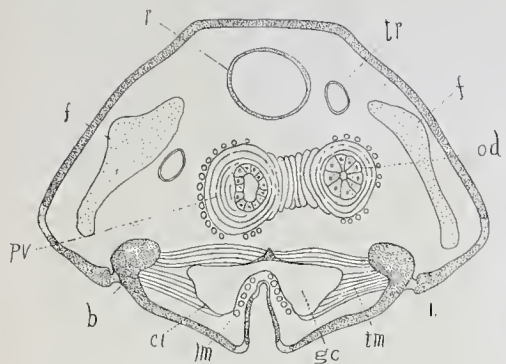
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